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The purpose of this study was to evaluate the cost effectiveness of instructional support delivered at job sites under the direction and control of a centralized Computer Managed Instruction (CMI) system. The project has five phases: a feasibility study; a demonstration design; the demonstration preparation; the demonstration; and the evaluation of the demonstration. This report addresses the second phase (demonstration design) and a portion of the third (the demonstration preparation). The tasks described in this report include developing an economic rationale, designing and developing a research plan and a demonstration plan, specifying tasking requirements, developing a demonstration master plan, and the development of the data collection instruments. (Author)

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TAEG Report No. 49

COMPUTER MANAGED INSTRUCTION AT REMOTE SITES: PHASES II—III, A DEMONSTRATION DESIGN

U.S. DEPARTMENT OF HEALTH,
EDUCATION & WELFARE
NATIONAL INSTITUTE OF
EDUCATION

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The purpose of the study was to evaluate the cost effectiveness of instructional support delivered at job sites under the direction and control of a centralized Computer Managed Instruction (CMI) system. The project has five phases: a feasibility study; a demonstration design; the demonstration preparation; the demonstration; and the evaluation of the demonstration. This report addresses the second phase (demonstration design) and a portion of the third (the demonstration preparation). The tasks described in this report

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FOREWORD

The U.S. Navy, facing rising costs associated with training, has attempted to improve cost-effectiveness relative to training by developing a self-paced Computer Managed Instruction (CMI) System. Initial CMI training systems have been successful. Further methods for developing even greater savings have been examined including the use of communication satellites and other technologies as a delivery vehicle for CMI at remote operational sites. The project title was originally derived from the Communication Satellite Concept and is called Computer Managed Instruction by Satellite (COMISAT).

The project is sponsored by the Cybernetics Technology Office, Defense Advanced Research Projects Agency (ARPA) and the Research and Program Development Office, Chief of Naval Education and Training (CNET). CNET's Training Analysis and Evaluation Group (TAEG) serves as the COMISAT Project Officer for CNET and as the Contracting Officer's Technical Representative (COTR).

Planning Research Corporation Information Sciences Company, working with ARPA and CNET/TAEG, was responsible for the project background research and has responsibility for the design and preparation phases.

Others involved in the project include various commands and agencies of the U.S. Navy. COMNAVTELCOMM is to provide the facility for the demonstration; NAVCOMMSTA Stockton, CA is to provide the required students for the demonstration; the Naval Telecommunications Division, Chief of Naval Operations, is to approve the use of the Navy telecommunications system for the demonstration; the Management Instructional Information Systems Activity is to provide computer support; the Chief of Naval Technical Training is to provide the CMI course and associated materials; and the Navy Personnel Research and Development Center is to provide additional assistance in those areas where they have participated in relevant research activities.

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Chapter I

INTRODUCTION

A. Background

This report addresses the second and a portion of the third phase of the project originally entitled Computer Managed Instruction by Satellite (COMISAT). The project is sponsored by the Cybernetics Technology Office, Defense Advanced Research Projects Agency (ARPA) and the Research and Program Development Office, Chief of Naval Education and Training (CNET). CNET's Training Analysis and Evaluation Group (TAEG) serves as the COMISAT Project Officer for CNET and as the Contracting Officer's Technical Representative (COTR). Planning Research Corporation Information Sciences Company (PRC/ISC), working with ARPA and CNET/TAEG, is responsible for the project background research and the design, development, implementation, and evaluation of the demonstration.

1. Project Genesis

The acceleration of military personnel costs has caused military personnel managers to pursue ways of maximizing the return on dollars expended and, where possible, to stabilize or reduce costs. One major cause of accelerated costs is training, a continuing and necessary requirement.

In an attempt to address the training cost problem, the U.S. Navy developed a self-paced, computer managed instruction (CMI) system. The systems approach to instructional development was used to provide a set of prioritized skills derived from task analysis. These skills were translated into learning objectives and then into learning modules with accompanying self-paced learning materials and performance measures. The learning modules were then automated through CMI.

Thus far, the achievements of the CMI system, which provides a means for guiding and counseling students through a continuum of instruction with only minimal staff support, have been dramatic. The system has significantly reduced course time, instructional and support personnel, and student attrition; it has significantly increased student end-of-course achievement levels; and it has been estimated to have saved over $10 million in FY 1975 alone (Reference 1).

The success of the CMI system in the continental United States prompted CNET and ARPA to become interested in extending the system to Navy personnel at sea or other remote locations. More specifically, the question is being asked: Can further improvements in resource use be effected by delivering CMI supported training to job sites?

2. Purpose and Objectives

The purpose of the research project is to evaluate the cost-effectiveness of instructional support delivered at job sites under the direction and control of a centralized CMI system. The specific objectives of the effort are to determine:

- Whether CMI delivered to remote sites produces the same learning effectiveness as CMI does in the learning center environment
- Whether the attitudes of students, trainers, and key remote site personnel are supportive of CMI delivered to remote sites
- Whether CMI delivered to remote sites is as economical as CMI in the learning center environment

- Personnel requirements
- Personnel training requirements
- Organization and management structure requirements
- Remote site space requirements and operational procedures for effective use of a CMI training support system
- Equipment, maintenance, spare parts, and logistics requirements

3. Project Phases

The research effort has five phases: a feasibility study; a demonstration design; the demonstration preparation; the demonstration; and the evaluation of the demonstration.

The first phase included gathering background data and information, establishing resource requirements, and setting the parameters for the demonstration; this was the subject of the December 1976 TAEG Report No. 44 (Reference 2). The second phase, the primary subject of this report, involved determining the most useful approach to conduct the demonstration. The research approach to be undertaken was defined and a detailed plan for its preparation, execution, and evaluation specified. The third phase, a small portion of which is addressed in this report, involves preparation activities; and, the fourth phase includes the execution and monitoring of the planned demonstration activities. In the fourth phase, adjustments or changes will be made as needed, data and information collected and prepared for analysis, and initial analyses conducted. The fifth phase involves summing up the results of the demonstration, drawing conclusions, and making recommendations.

It should be noted that in order to insure that the development and execution of the demonstration is progressing satisfactorily, a formative evaluation is being conducted. The purpose is to furnish project personnel with information helpful to them in assessing the progress of the demonstration.

B. Evolution of the Design

1. Introduction

The fundamental research question posed at the outset of the COMISAT project was: Can training costs be reduced and the manning situation of remote job sites, sea or land, be improved by providing CMI training onsite? Two approaches for implementing CMI operationally were explored during the feasibility study to answer this question.

The highest pay-off potential was projected to involve personnel just entering the service who would be partially trained at an A-School and then be assigned to a remote sea or land site for the remainder of their A-School training. The rationale was that:

- The courses on CMI were primarily suited for new personnel because they were A-School courses or preparation for A-School courses
- Reducing time at training centers would reduce associated costs while improving the manning situation, particularly on ships
- Operational readiness possibly could be improved by marrying the formal CMI training with on-the-job training (OJT)

Sea sites were given priority because they were thought to be a "worst case" environment when considering operational requirements and their limited physical facilities. It was felt that if it worked in this environment, CMI supported training may work at any job site.

The second approach was to provide Navy personnel already assigned to a job site with an existing CMI course that would meet a site training need. The rationale was that:

- Reducing the need for formal training would reduce associated costs
- Reducing the absence of personnel due to formal training would improve the manning situation
- Operational training possibly could be improved by providing and combining formal training with normal daily job duties

In both approaches, five basic requirements had to be met to execute a demonstration:

- Approval for the use of an existing communications system
- Approval for the use of the U.S. Navy CMI computer facility at Millington, Tennessee
- Selection of a validated CMI course
- Identification and commitment of an operational site for the conduct of the demonstration
- Identification and commitment of specific U.S. Navy personnel to participate as subjects and to act in a support capacity

In terms of the preferred approach, the first four requirements were met. Tentative approval was obtained to use:

- The standard Navy communications system to include the Navy satellite system, if required
- The Navy CMI facility
- The Radioman (RM) CMI course
- NAVCOMMSTA Stockton (a ship could not be obtained)

Nevertheless, BUPERS did not grant permission for the personnel. CNET had requested that approximately 30 new Navy personnel be assigned to the experimental group to be partially trained at the A-School and then assigned to the demonstration site as additions to the normal complement of personnel.

This was to insure that the demonstration site would not be penalized by partially trained and inexperienced personnel being assigned to regular billets. BUPERS maintained that by assigning additional personnel in a single rate to a single site the billeting limit would be exceeded and, at the same time, deprive other sites of personnel. This is particularly critical in the RM field, where there is a shortage of personnel.

As a result of the BUPERS decision, the second research approach was pursued and approval was obtained to use:

- The standard Navy terrestrial communications system (Because Stockton was accessible with good quality landline the need for the satellite was eliminated.)
- The Navy CMI facility
- The A-School Basic Electricity and Electronics (BE/E) CMI course
- NAVCOMMSTA Stockton
- Existing RM personnel at Stockton

2. Stockton Demonstration Site

NAVCOMMSTA Stockton, like the majority of the operational sites, has a great number of training requirements, but a limited budget to meet these needs. Many of the courses are offered at locations a considerable distance from Stockton, thus requiring absence from the site of needed personnel and the expenditure of large sums of money each year for travel and per diem. The Stockton commander sees the COMISAT project concept as a possible approach for meeting some of the Stockton training needs.

Since there are a limited number of U.S. Navy courses supported by CMI (all related to A-School training), it was necessary to find a match between Stockton training needs and a CMI course.

At the same time the selected course must permit the fulfillment of the project purpose.

3. Demonstration Course

NAVCOMMSTA Stockton RM personnel have a special training requirement which provides an opportunity to test an existing CMI course. RM's are not required to take the A-School BE/E course. However, as time goes on they find that a BE/E background can be useful both on the job, and in taking the electricity and electronics portion of the E4, E5, and E6 rate advancement exams. Exam scores of Stockton personnel provide strong evidence of the need for BE/E training.

The method currently being used to acquire a background in electronics and electricity is to enroll in a correspondence course. However, this has not been a popular approach due to the difficulty of the materials and the self discipline required. An attractive alternative is to use the first 14 modules of the self-paced CMI supported BE/E course as the basis for study. To indicate the potential interest in such an offering, the Education Service Officer (ESO) at Stockton surveyed site personnel and found 48 out of about 200 eligible personnel interested in taking the course.

From the COMISAT point of view it was questionable that a comparable control group could be established if the BE/E course was used for the demonstration since personnel taking BE/E training are usually personnel just entering the service. However, it was found that thousands of individuals have taken the course, and that occasionally Navy personnel are sent from their duty station to take the course. Consequently, it was assumed that the historical files would contain a sufficient number of individuals similar to the Stockton personnel to establish a control group. It should therefore be possible to make a comparison between the academic achievement of personnel returning to a training center for training, and those receiving the same training at their operational site. Use of the BE/E course would also permit the analysis of the cost differences in providing the training at a training center and at the remote site. With these advantages, plus the need for BE/E training, the CMI supported BE/E course was chosen for the demonstration.

The demonstration, in addition to testing the delivery of CMI to an operational site, offers the opportunity to compare the effectiveness of CMI and correspondence courses in the same setting. This will be done by having volunteers at Stockton outlying sites take the traditional correspondence course in electricity and electronics. At the end of the demonstration a specially prepared exam will be given to both CMI and correspondence course graduates to compare what they have learned. In order to validate the exam, it will also be given to a control group with no formal training in electricity and electronics.

4. Attitude Survey

A basic problem associated with using "historical record personnel" as a control group is that attitude surveys cannot be administered. Consequently, it is not possible to compare the control and experimental groups relative to student attitude and resultant academic achievement. However, it is possible to compare the attitudes of students toward CMI per se and toward receiving such training at the job site or at a training center regardless of the content. From a control group point of view, this can be accomplished by administering the attitude survey to any student returning from a job site to a training center to take any CMI supported training course. This approach was deemed acceptable.

5. Demonstration Schedule

The decision to use the Stockton site for the demonstration significantly impacts the schedule of events by reducing the time needed to execute the various phases.

According to the schedule of events developed in the feasibility study, the preparation for the demonstration was to take place from July through December 1977, the demonstration was scheduled for January through June 1978, and the evaluation was scheduled for August through November. However, due to operational constraints at Stockton, including a requirement for a major training program (COMPARS), the Stockton commander requested that the demonstration be initiated in September 1977 and run through February 1978. This leaves two months for the demonstration preparation, July and August 1977. The evaluation phase would run from March through June 1978.

The design work in this document reflects the change in schedule. Nevertheless, it is recognized that these changes may create a problem for agencies and organizations being tasked for resources; therefore, it may not be possible to keep the schedule of events envisaged in this report. Every effort will be made to minimize the slip page.

C. Demonstration Overview

A representative sample of U.S. Navy RM personnel assigned to NAVCOMMSTA Stockton will be chosen from a group of volunteers. Beginning in September they will enroll in the common core of the BE/E Course File 69. They will spend an average of 10 hours of watch time per watch string on the course until the common core is completed. Since the course is self-paced, the time-to-complete will vary for each student, however, the maximum time required to complete the course should be no more than 20 weeks.

The students will do their course work in an area set aside in the Fleet Communications Center, where learning materials, equipment, and supervisory personnel will be located. Periodically they will interact with the Millington, Tennessee computer center through the use of an Opscan 12/17 optical reader and a Terminet teletype. The Opscan will be used to feed test answer sheets into the computer for grading, and the Terminet will be used for student feedback providing test results and prescriptive information.

During portions of the day and eve watches a Learning Supervisor (LS) will be available to address course and equipment related questions. When the LS is not available, the senior maintenance electronics technician (ET) will take over these responsibilities.

Communication between the student and the computer center will take place using a commercial dedicated phone line between the Fleet Communications Center at Stockton and the Management Instructional Information Systems Activity (MIISA) CMI concentrator at the training center at San Diego. MIISA lines will connect the training center at San Diego with the training center at Millington. Stockton will be on-line with the CMI computer center from 0600 to 1830 Pacific Coast time, five days a week. Materials developed at other times will be saved and submitted at 0600 the next day on which the computer is operating.

The correspondence course students at the outlying Stockton sites will also be permitted to study an average of 10 hours per watch string. At that rate, they should complete the course within 16 weeks. After completing the course, they and the CMI course graduates will take the special exam on electricity and electronics.

D. Organization of the Report

The results of the design work are presented in the following chapters: Chapter II presents the economic rationale for the effort. Chapter III describes the research design. Chapter IV presents the demonstration design, specifying the activities required to conduct the demonstration, carry out the research, and provide support in terms of communication lines, lab equipment, course materials and personnel. The formal tasking required to obtain the support of different Navy organizations is briefly described in Chapter V. The master plan linking the various activities is given in Chapter VI. Supporting materials are contained in a series of appendices.

Chapter II

ECONOMIC RATIONALE FOR COMISAT

A. Introduction

An economic analysis of the COMISAT concept was carried out to determine its feasibility as an operational system. The investigation followed the guidelines prescribed by DODI 7041.3 and SECNAVINST 7000.24A (Reference 3). The following section describes the key findings of the analysis and presents recommendations. This is followed by an overview of the methodology used in the analysis. The details of the analytical procedures are presented in Appendices A through G.

B. Key Findings and Recommendations

1. Reduction in Navy Training Costs

The analysis shows that full implementation of the COMISAT concept could result in present value net savings of 18 to 35 million dollars based on an eight-year program and a 10-percent discount rate,[1] and depending on the set of conditions assumed as shown in Figure II-1. The top half of Table II-1 shows the incremental investment and savings-to-investment (or benefits to investment) ratio associated with the savings for a representative case. It should be noted that the present value saving estimates are probably low since the analysis utilized conservative approximations of the economic benefits of COMISAT.

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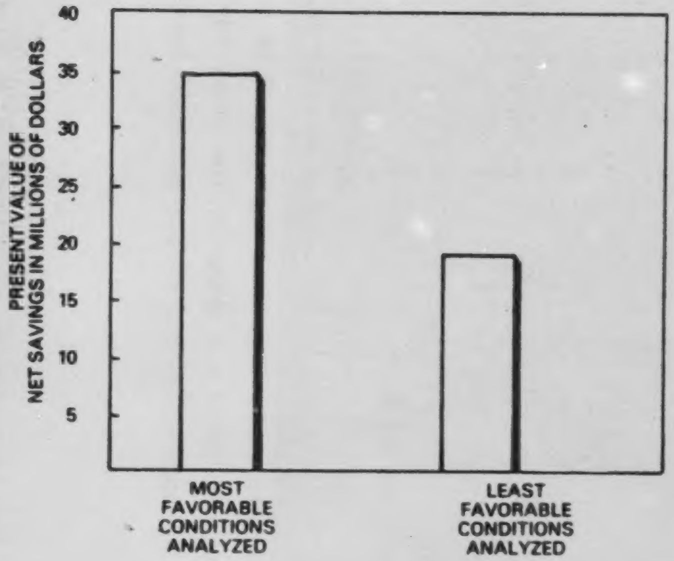
[1] The present value concept, and the relation of present value to annual costs and savings are described in Appendix A.



MOST FAVORABLE CONDITIONS:[2]

- LOW TERMINAL BREAKDOWN RATE (3/YR. LANDSITES, 4/YR. SHIPS)
- 80% OF SKILL PROGRESSION COURSES ARE PRACTICAL FOR CMI
- 20% OF STUDENT TRAINING TIME IS SAVED BY CMI

LEAST FAVORABLE CONDITIONS:[2]

- HIGH TERMINAL BREAKDOWN RATE (4/YR. LAND, 6/YR. SHIPS)
- 60% OF SKILL PROGRESSION COURSES ARE PRACTICAL FOR CMI
- 15% OF STUDENT TRAINING TIME IS SAVED BY CMI

[1]EIGHT YEAR PROGRAM, 10% DISCOUNT FACTOR

[2]SEE TEXT FOR A DISCUSSION OF THESE CONDITIONS

Figure II-1. Summary of Potential COMISAT Savings

Table II-1. Characteristics of a Representative COMISAT Program

Financial	
Present value net savings (eight year program, 10% discount)	$29,777,000
Annual Savings [1]	$10,858,000
Incremental investment	$31,582,000
Savings-to-investment ratio	1.94
Operational	
Number of CMI courses	69
Number of sites	
— ships	411
— CONUS land bases	80
— overseas land bases	47
Number of students	20,881
Proportion of CMI students served at sites	96.7%

These savings are achieved by using CMI to train personnel who normally take skill progression courses at the training center which requires a permanent change of station (PCS) or temporary duty (TDY) assignment. The major source of COMISAT savings is the reduction in travel and living expenses achieved by having the students remain at their operational land site or ship.[1] The analysis shows that on the order of 30 percent or more of skill progression students who ordinarily travel to a training center could be served by COMISAT.[1] This means that more than 20,000 students a year, representing more than one tenth of the total number of Navy students trained per year would be affected. The bottom of Table II-1 lists the number of sites and trainees served for the representative case.

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[1] An explanation of the calculation and interpretation of annual savings can be found in Appendix A.

The uncertainties which account for the variation in the above results have not been resolved as discussed in the next section. However, even the lower values of savings are large enough to warrant serious consideration by the Navy of implementing COMISAT, and are certainly large enough to justify the proposed demonstration.

These conclusions are also important for the other services. If equivalent savings can be achieved for each of the other two services, which is reasonable to expect, then total Defense Department savings could have a present value of between 54 and 105 million dollars for an eight year program.

2. Uncertainties

The variation in the savings quoted above is due to uncer tainties in three areas:

- It is not known what percentage of Navy skill progression courses are suitable for conversion to CMI. Values of 60 to 80 percent were examined in this analysis. A value of 70 percent was picked as nominal based on discussions with Navy training personnel and a review of courses. A 10 percent variation was used to analyze the sensitivity of the results to the nominal assumptions.
- The frequency of terminal breakdowns under operational conditions on land and at sea is not known with certainty. Manufacturer estimates were increased by one third on land (from three to four per year) and one half at sea (from four to six per year) to assess the sensitivity of the results.

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[1] An explanation of the calculation and interpretation of annual savings can be found in Appendix A.

- The amount of student time saved by having CMI instead of conventional instruction is estimated between 10 and 20 percent (Reference 4). Both cases were considered here.

The analysis shows that the resultant change in savings attributable to (1) the change in annual terminal breakdown rates from three to four on land and four to six on ships, (2) a 10 percent change in the proportion of courses convertible to CMI, and (3) a five percent change in student time savings with CMI would each result in a change of about five million dollars in present value savings. That corresponds to an annual change in savings of about one million dollars.

Table II-2 lists the results for the two cases which were developed in the greatest detail. The cases show the effect of different remote site terminal breakdown rates on the savings achieved, the number of courses that can be delivered, and on the number of ships and land sites served.

Table II-2. Summary of Results

Item	Low Maintenance[1]	High Maintenance[2]
Number of CMI courses	69	67
Number of sites	538	434
— ships	411	328
— CONUS	80	66
— overseas	47	40
Proportion of CMI students served at the sites	96.7%	92%
Annual net savings	$10,858,000	$10,190,000
Present value of savings (eight year program)	$29,777,000	$26,384,000
Incremental Investment	$31,582,000	$32,096,000
Savings-to-Investment Ratio	1.94	1.82

[1] The low maintenance case assumes that three breakdowns occur each year on land and four breakdowns occur each year at sea.

[2] The high maintenance case assumes four breakdowns per year on land and six at sea. This case also assumes that due to higher breakdown rates spare terminals will be required at all sites serviced by Navy personnel.

There is a decrease of five million dollars in present value savings for increases in breakdown rates of one third on land and one half at sea. The greatest impact is at sea where 83 fewer ships could be served with the higher breakdown rates. The number of courses that can be delivered decreases from 69 to 67 because of the higher maintenance costs. In both cases, more than 90 percent of the students who normally travel to a training center to attend the feasible CMI courses would receive the training at their base or ship.

These two cases assume that 70 percent of Navy skill progression courses are operationally suitable for conversion to CMI, and that CMI requires 20 percent less time than conventional instruction. The effect on savings of varying the latter two assumptions is shown in Table II-3. A 10 percent change in the number of courses suitable for CMI results in a change in the present value of the savings of about five million dollars.

Table II-3. Sensitivity of Present Value Savings to Time Savings and CMI Convertibility Assumptions: Low Maintenance Case

Percentage of Skill Progression Courses Convertible to CMI	Percentage of Student Time Saved		
	10%	15%	20%
60%	$17,627,000	$21,326,000	$25,025,000[1]
70%	$21,770,000	$26,085,000	$30,401,000
80%	$25,913,000	$30,845,000	$35,777,000

[1] The values contained in Table II-3 are estimates based on a closed form expression for net COMISAT cost. Hence, this number differs slightly from the present value savings figure in Table II-2.

The effect of a change in student time savings due to the use of CMI is greater when there is a higher proportion of courses suitable for conversion. When 60 percent of the skill progression courses are suitable for CMI, a 10 percent change in student time savings (from 10 to 20 percent) changes the present value savings by $7,398,000 (from $17,627,000 to $25,025,000). However, when 80 percent of the courses are convertible, the same change in student time savings changes the present value of savings by $9,864,000 (from $25,913,000 to $35,777,000).

The lowest estimate of present value savings is 14 million dollars, assuming high maintenance, 60 percent course convertibility to CMI, and 10 percent student time savings with CMI.

The savings results are sensitive to other assumptions, but not to the same extent as those just discussed. For example, the results in Tables II-1 to II-3 assume that land sites within 30 miles of a central location can be served by one terminal at that location. Courier service would carry inputs to the terminal and return messages to the base. If that is not feasible, present value savings would be reduced by one million dollars.

3. Communication Requirements

Another concern is for the availability of communications lines. As the number of CMI students increases, the capacity required will increase the Navy communications required, particularly from the CMI computer to the remote sites. To assess this, the capacity required was estimated[1] based on the characteristics of the CMI messages. The total communications load at the average site is estimated to be 0.28 characters per second, and at the CMI computer, 150 characters per second. This would appear to be a reasonable load for the AUTODIN II system.

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[1] See Appendix B.

4. Recommendations

Since the economic analysis shows large potential savings, it is important to test a major assumption, i.e., that the COMISAT concept is workable at a remote site. It is necessary to show that supporting personnel assignments can be carried out as assumed for the analysis, that students can take the time on site for training, and that, under those conditions, the training is effective. The demonstration proposed in this document would help confirm that the concept is practical and desirable.

Additional investigation of the economic benefits of COMISAT should be conducted:

- The Navy courses should be surveyed in detail to determine suitability for CMI, enrollments, and lengths.
- A better approximation of equipment breakdown rates should be obtained. In the event that these rates are higher than those in the high maintenance case explored here, the manufacturer should be consulted in an attempt to improve maintainability characteristics.
- An investigation should be made to determine whether the average travel and living expenses used in this analysis adequately reflect the range of costs and the usual payment procedures.
- The availability, cost, and feasibility of courier service between nearby sites should be investigated to obtain an improved estimate of the extent to which clustering of sites is practical and profitable.
- The available capacity of AUTODIN at each site should be assessed to insure that the additional demand due to COMISAT

can be adequately met. In particular, the AUTODIN II capacity to the CMI computer will have to be large enough to accommodate the new load.[1]

C. Background and Approach

1. Background

There are Navy courses in self-paced instruction format, some of which are already programmed onto the CMI computer at Memphis and available for CMI instruction at locations such as Memphis, Great Lakes, San Diego, and Orlando. In the future, CNET intends to expand the CMI capability by:

- Developing and programming additional courses into CMI
- Enlarging the CMI computer to accommodate the increased course and student loads

It is possible that the COMISAT project could play a significant role in these future plans. The need for an additional training center and the operations of the existing training centers might be impacted.

The benefits which could be expected from an implementation of COMISAT include those attributable to CMI and those attributable to remote site training. Naval experience (Reference 1) indicates that utilization of CMI at a training center yields:

- A reduction in course time
- A reduction of instructional and support personnel

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[1] The net cost of these new lines was assumed to be the same as the additional communications cost for the CMI system enlarged to include these skill progression courses.

- An increase in student end-of-course achievement levels
- A reduction in student attrition.

These benefits could also be expected from CMI at operational Navy sites. In addition, COMISAT would allow the student to remain on the job while training, thus resulting in:

- A saving in travel and living cost
- Training for personnel unable to leave the operational site
- An increase in the availability of key personnel to handle contingencies at the site

The elements of cost and saving involved in achieving the above benefits have never been completely defined. Determination of important cost elements was a necessary step in the analysis procedure.

Table II-4 contains an overview of the elements of cost and saving used in this analysis and attributable to the COMISAT system as compared with the conventional/CMI system. Certain courses can be economically justified for CMI development by savings at training centers. The only cost to COMISAT of utilizing these courses at remote sites is the cost of the site terminals required. Savings achieved by offering these courses through COMISAT include student travel and living costs and the reduction in terminal cost at training centers. Other courses could not be economically justified for use only at training centers, but could be justified by savings achieved through COMISAT. For such courses the costs to COMISAT include not only the site terminal cost but also the CMI course development, coding and maintenance costs, and computer leasing costs. Also, additional terminals required to teach these courses at the training center to students who cannot be reached through COMISAT must be considered under COMISAT costs. The savings

Table II-4. Summary of COMISAT Costs and Savings Elements

	Courses Justified For Training Center Use	Additional Courses Justified Only By COMISAT
Costs for COMISAT	Terminal cost at sites	Terminal cost at additional sites Course development, coding and maintenance Computer leasing Training center terminals
Savings due to COMISAT	Travel and living costs saved by receiving training at the operational land base or ship Reduced number of training center terminals	Time and living costs saved by CMI over conventional instruction Travel and living costs saved by receiving training at the operational land base or ship

credited to COMISAT for these courses consist of the student travel and living expenses eliminated by training at the site, and time and living savings gained through decreased student training time.

The analysis of these cost elements consisted of four steps:

- Determine courses economically feasible for CMI at training centers
- Determine economically feasible COMISAT sites for delivery of the CMI courses justified for use at training centers
- Using the sites identified in the second step, determine additional CMI courses justified by COMISAT savings
- For the complete set of training center-justified and COMISAT-justified CMI courses, determine the number of COMISAT sites for which savings are maximized.

Each of these steps are discussed in detail in the next section.

2. The Approach

a. Determination of Courses Economically Feasible for CMI at the Training Centers

(1) The Courses

The first step taken in analyzing courses for CMI development was to obtain data on overall training enrollments and individual course enrollments. The necessary data on annual overall training loads is summarized in Table II-5 (Reference 5)[1].

Six distinct training segments are identified by this data. There are three categories of courses offered: initial skill training, skill progression training, and functional training. Initial skill training consists of Class A courses offered immediately after recruit training. Skill progression training is made up of more advanced Class C type courses, offered to sailors who have already had some work experience and are preparing themselves for an advanced rating. Finally, functional training consists of short duration training of shipboard duties given at the ports of fleet concentration such as San Diego.

There are also two types of students: those on permanent change of station (PCS) and those on temporary duty (TDY). Those on permanent change of station include recruits going from recruit training to a training center and then to fleet or shore stations, and sailors going from fleet or shore stations to a training center and then to new duty stations. Temporary duty occurs when the sailor leaves his station for a short period of time, such as to go to a training center, and then returns to his permanent station.

The most likely candidates for COMISAT instruction are those taking skill progression training. The students in these

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[1] See Appendix C for original data.

Table II-5. Navy FY 78 Training Loads

Category	PCS	TDY	Total
Initial Skill Training			
1. Entrants	157,833	6,269	164,102
2. Graduates	156,073	6,214	162,287
3. Average Course Length (days)	42	42	42
4. Loads Average on Board (AOB)	19,152	570	19,722
5. Percentage of Loads(1)	57%	2%	59%
Skill Progression Training			
1. Entrants	30,042	32,867	62,909
2. Graduates	29,336	32,330	61,666
3. Average Course Length (days)	51	51	51
4. Loads Average on Board (AOB)	7,274	2,526	9,800
5. Percentage of Loads(1)	22%	8%	30%
Functional Training			
1. Entrants	22,226	329,340	351,566
2. Graduates	21,611	320,619	342,230
3. Average Course Length (days)	4	4	4
4. Loads Average on Board (AOB)	1,224	2,863	4,097
5. Percentage of Loads(1)	4%	9%	13%
Grand Total			
1. Entrants			578,577
2. Graduates			566,183
3. Average Course Length (days)			----------
4. Loads Average on Board (AOB)			33,619
5. Percentage of Loads(1)			100(2)

(1) Percentage of loads = percentage of total CNET population enrolled

(2) A 2% error due to roundoff is found if the individual numbers are added

groups are productively employed before their training and could continue to carry out their duties, although at a reduced level, if they were to receive training on board ship or at a land base. The group taking initial skill training on TDY was not included in the analysis even though it might actually benefit from COMISAT, because it is relatively small and data on initial skill courses are not readily available for use in this analysis. Initial skill students on PCS are not likely candidates for CMI because their lack of skills makes them of little use while training at the site. In this regard, operational commanders have been found to oppose the idea of placing untrained men at their sites or on board their ships. Finally, functional training segments are not considered in the study since this instruction is primarily port-side team training and is essentially delivered to the remote site already. Hence, in this analysis, the only students considered as candidates for COMISAT are those in the skill progression groups.

Having identified the candidate training segment, the next step is to obtain data on course enrollments. The only obtainable data on individual enrollments for skill progression courses are the title, number of graduates, and course length for each of the ten highest volume skill progression courses (Reference 5). Average attendance and student man-days have to be estimated.[1] The derived enrollment information for these 10 courses is given in Table II-6.

Enrollment data for additional courses are generated by fitting a curve through the known populations for the 10 highest volume courses and extrapolating.[2]

With all data on enrollment and course length complete, the courses eligible for conversion to CMI are identified by calculating and comparing costs and savings to determine those which

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[1] See Appendix D.

[2] See Appendix D.

Table II-6. Ten Specialized Skill Courses Producing Most Graduates

Title	Number of Grads	Average Attendance	Length (Calendar Days)	Student Man-Days
1. Instructor Basic	3,110	3,141	24	75,384
2. Career Information Counselor	1,323	1,336	26	34,736
3. *Nuclear Propulsion Plant Operator Mechanical	1,174	--------	182	-----------
4. Sonar Electronics Intermediate	960	970	117	113,490
5. Air Conditioning and Refrigeration	611	617	53	32,701
6. *Nuclear Propulsion Plant Operator Electrical	608	--------	182	-----------
7. International Morse Code	586	592	82	48,544
8. *Nuclear Propulsion Plant Operator Reactor Control	512	--------	182	-----------
9. Marine Gas Turbine Basic	401	405	40	16,200
10. Surface Explosive Ordnance Disposal Refresher	400	404	28	11,312
Total (10 Courses)	9,685			
Total (7 Courses)	7,391			332,367

*Not suitable for CMI format.

have a net savings.[1] The following two sections describe the procedures and assumptions.

(2) CMI Costs at the Training Centers

The costs associated with the transfer of traditional courses to CMI for training center use include development and coding, course maintenance, computer leasing, and terminal purchase and maintenance. Before a course can be made available on CMI, it must be developed into the proper CMI format and coded for the CMI computer. Assuming the materials are less than 10 percent audio visual, the development cost is estimated to be $2,930 per hour of instruction

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[1] See Appendix E.

(Reference 6). The cost of coding is between $200 and $300 per instruction hour, and a mean coding cost of $250 per hour is used in the calculations. The estimated total development and coding cost per hour is $3,180. However, since CNET is planning to redevelop courses for some 70 to 80 ratings in the next 4 to 7 years, those courses would cost $1,130 per hour even if they are not developed for CMI. This results in an incremental cost per hour of training for developing a CMI course of:

$3,180 - $1,130 = $2,050.

It was assumed that by expending five percent of the incremental development and coding costs ($2,050 per hour of training) each year, the CMI program can be adequately maintained for 12 years (Reference 6). For an average course of 255 hours, annual course maintenance is

(255)($2,050)(.05) = $26,137.

The computer leasing costs have two aspects (Reference 7): expansion of the computer main frame, and expansion of the number of peripherals, particularly the disk packs. The current main frame accommodates 6,000 average on board (AOB). The planned expansion to a Model 60 computer will have a maximum capacity of 16,000 AOB students. It is assumed that this expansion would accommodate the additional skill progression courses. If the assumption is not true, the computer could be expanded to a Model 80, at additional cost. With the current mix of courses on the computer, one disk pack would be required for each additional 1,000 AOB students, assuming an average of one student response per hour. This would cost $800 per month. However, if the volume of students per course decreased, as it would if many additional courses were added, the requirement might be more than one disk pack per 1,000 students. For purposes of this analysis, it is assumed that an additional 1.5 disk packs would be required for each 1,000 students. Note that the final results have low sensitivity to the required number of disk packs so that the relatively arbitrary nature of the figure used is of little consequence. Thus, the annual cost of disk packs for each 1,000 AOB students is approximately

$$(\$800)(12)(1.5) = \$14,400.$$

Since the computer mainframe will be expanded whether or not it is used for CMI, no computer expansion costs are incurred by development of courses into CMI. Therefore, the only computer cost involved is the leasing cost of the disk packs.

The purchase of terminals is cheaper than leasing, based on the data in Table II-7. The purchase price for the terminal cluster is $14,250 and the annual maintenance is $1,764. The present value of the maintenance over eight years is $9,873.

One cluster is usually required for each 60 students, and it is assumed that clusters could be shared. Therefore a proportional cluster cost is assigned to each course on the basis of the AOB student load. A course with 30 students would be charged half the cost of the cluster under those circumstances.

(3) CMI Savings at the Training Center

The savings achievable by implementing CMI courses at a training center accrue for the most part from reduced student pay and living costs due to decreased training time. There are other sources of savings, such as reduced instructor time, but those are not considered significant enough to justify the additional effort required to include them in the analysis. Hence the savings identified here are conservative estimates.

Table II-7. Naval Training Center CMI Cluster Equipment and Associated Costs

Item	Purchase Option		Lease Option (per month)
	Investment	Maintenance	
1 - OPSCAN 17 (Basic Terminal)	$ 8,998		$261
Maintenance		$ 69/mo.	69
1 - OPSCAN Automatic Feed	652		27
Maintenance		5/mo.	5
1 - Terminet 1200	4,200		132
Maintenance		68/mo.	68
1 - GDC 202-9D Modem	400		13
Maintenance		5/mo.	5
Totals	$14,250 +	$147/mo.	$580/mo.

Presearch Corporation's analysis of eight courses that underwent Instructional System Development (ISD) type development shows an average saving of 20 percent of student man-hours of attendance time, as compared with the time required using traditional instruction (Reference 4). This planning factor is used throughout the analysis, and the sensitivity of the results to the parameter is tested as described in Section B. Using the 20 percent student time saving factor, the man-hour savings for each course are converted into equivalent student salary savings.[1]

While attending a training center course a student is provided food at the same cost to the Navy as at his operational site. However, he or she is also given $2.50 per day in cash to cover miscellaneous, out-of-pocket living expenses. Due to the reduced

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[1] See Appendix E.

Course Number	Grad-uates	Annual average students	Course time (hours)	Average students on board (AOB)	Investment cost (course development and coding)	Investment Cost (training center terminals)	Terminal Maintenance Cost/Year	Program maintenance cost/year
1	3,110	3,141	120	206.5	$ 246,000	$49,044	$8,071	$123,000
2	1,323	1,338	130	95.18	226,500	22,805	2,798	13,325
3	——	——	—	——	——	——	——	——
4	980	970	586	310.8	1,199,260	73,815	9,138	59,962
5	611	617	285	89.60	543,280	16,530	2,370	27,162
6	——	——	—	——	——	——	——	——
7	588	592	410	138.0	840,500	32,775	4,057	42,025
8	——	——	—	——	——	——	——	——
9	401	405	200	44.38	410,000	10,840	1,305	20,500
10	400	404	140	30.99	287,000	7,380	911	14,350
11	447	415	255	63.08	522,780	14,981	1,856	26,137
12	427	431	255	60.26	522,780	14,312	1,772	26,137
13	409	413	255	57.71	522,780	13,706	1,697	26,137
14	383	387	255	55.46	522,750	13,172	1,631	26,137
15	379	383	255	53.49	522,780	12,704	1,573	26,137
16	365	370	255	51.85	522,750	12,267	1,518	26,137
17	366	369	255	55.1	522,780	11,899	1,473	26,137
18	343	346	255	48.4	522,750	11,486	1,423	26,137
Total of top 7 courses	7,391			910.45				
Total next 7 courses	2,776			391.75				
Next 7 courses 70% of total	1,943			274.22				
Grand total (top 7 plus 70% of next 7)	9,334			1,184.67				

Table II-8. Analysis of High Volume Skill Progression Courses

Computer leasing cost/year	Total annual cost	Present value of annual costs	Present value of total costs	Value of student time saved/yr.	Total living cost savings/ year	Total annual savings	Present value of total savings	Residual value of development and coding	Present value of net savings
$2,974	$21,346	$119,468	$ 414,512	$418,491	$3[illegible],694	$464,186	$2,542,073	38,253	2,166,814
1,371	17,494	97,916	387,021	191,041	17,[illegible]70	208,311	1,171,514	41,441	825,934
——	——	——	——	——	——	——	——	——	——
4,476	73,576	411,806	1,684,870	626,745	56,721	683,466	3,825,368	18,548	2,328,972
1,290	30,823	172,516	732,296	180,697	10,362	197,049	1,102,863	84,475	465,082
——	——	——	——	——	——	——	——	——	——
1,915	47,987	268,639	1,141,914	268,130	24,265	292,395	1,636,530	130,698	626,314
——	——	——	——	——	——	——	——	——	——
639	22,444	125,619	546,159	89,503	8,099	97,603	546,294	63,756	63,880
448	15,707	87,912	382,272	62,496	5,656	68,152	381,447	44,638	43,804
908	28,901	161,739	699,490	127,207	11,512	138,719	776,410	81,288	158,208
868	28,777	161,065	698,127	121,616	10,897	132,513	741,676	81,288	124,836
831	28,666	160,444	696,900	116,393	10,532	126,926	710,399	81,288	94,787
799	28,567	159,881	695,811	111,840	10,121	121,961	682,616	81,288	68,042
770	28,481	159,408	694,862	107,856	9,762	117,618	658,308	81,288	44,734
744	28,399	158,349	693,988	104,156	9,426	1,136,582	635,718	81,288	23,040
721	28,331	158,567	693,218	101,026	9,143	110,169	616,816	——	4,686
697	28,257	158,164	692,399	97,611	8,833	106,441	595,767	——	-15,344
			8,189,044				11,208,086		
			5,564,773				4,821,742		
			3,896,341				3,376,219		
			12,084,385				14,581,314		

training time, 20 percent of these living expenses are saved for each course.

The total costs and savings computed in this manner are discounted over eight years. Since the development and coding investment produces a course with a lifetime of twelve years, the discounted residual value of development and coding is treated as a credit to COMISAT. Therefore the resulting present values consistently represent an eight year program.[1] As Table II-8 indicates, this technique identifies the top 17 courses as feasible for CMI development. However, three of the first ten courses are nuclear training, and it is assumed that these would not be operationally practical for CMI. This same planning factor is applied to courses 11 through 17; so, on the average, only 70 percent of these courses are considered to have potential for CMI development and only 70 percent of these net savings are credited to CMI. The analysis of the sensitivity of the results to the value of this parameter is discussed in Section B.

b. Determination of Feasible COMISAT Sites

Implementation of CMI at the training centers results in net savings. COMISAT provides an opportunity for additional savings by delivering the courses to operational land bases and ships, and eliminating travel and living expenses of the students. Certain costs and savings occur to the same degree through both COMISAT and CMI at the training center. Such elements do not aid in differentiating between the two alternatives and were not explicitly calculated in this analysis. Hence, the cost elements discussed below consist entirely of differentiating costs and savings.

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[1] See Appendix A for a description of residual value and the method of computing its present value.

(1) Costs to COMISAT

The costs to COMISAT consist of the purchase or leasing price of the terminals, the cost of annual maintenance, and the cost of software changes to the CMI computer, required to interface with AUTODIN. The required equipment and its costs can be found in Table II-9 (Reference 8). Each terminal was assumed to have a lifetime of appproximately eight years. Since leasing over this period is much more expensive than purchase, only the purchase option is considered in this analysis. Quantity discounts are available as found in Table II-10 (Reference 8). The maintenance costs in Table II-7 are for sites in the continental United States (CONUS) 50 miles or less from an Opscan service location. Other CONUS sites may be maintained either by Opscan or by specially trained Naval electronic technicians (ET's). Overseas and ship sites must be serviced by ET's.

Table II-9. COMISAT Terminal Equipment and Cost

Item	Purchase Option		Lease Option (per month)
	Investment	Maintenance	
1 - OPSCAN 17 (Basic Terminal)	$ 8,998		$369
Maintenance of one		$69	69
1 - OPSCAN Automatic Feed	652		27
Maintenance		5	5
1 - Device 273[1]	1,620		74
1 - LRC Character[1]	180		
Maintenance of total equipment		6	6
Total	$11,450 +	$80/mo.	$550/mo.
Spares[2]	$ 6,529		

[1] Required for compatibility with AUTODIN.

[2] Based upon list of spares recommended by OPSCAN. These spares are required for all ship sites and land sites where a terminal is maintained by Navy personnel.

Table II-10. OPSCAN Discounts from GSA Schedule

Units	Percent Discount
1st	0
2nd - 30th	5
31st - 60th	10
61st - 90th	15
91st - 120th	20
121st - 150th	25
151st - 180th	30
181st - 210th	35
211th on up	40

The cost of service by Opscan personnel for sites greater than 50 miles from the service center (Reference 7) consists of:

- Travel costs of 18¢ per mile
- Labor cost of $30 per hour, including travel time
- An approximate annual parts cost of $600 obtained from Opscan's price for a service warranty

Labor cost was calculated assuming a mean time to repair of 2.5 hours per breakdown.

Service by an ET involves the following costs:

- An approximate labor cost of $75 per breakdown, assuming the same total Opscan labor cost per breakdown as for Opscan maintenance personnel
- An approximate annual parts costs of $400 per year based on the price of a service warranty with a 30 percent return on investment removed
- A spare parts inventory which can be purchased at an undiscounted base price of $6,529

The Opscan maintenance cost on a time and materials basis is less than the cost of the Navy maintaining the equipment itself for CONUS sites less than 90 miles from an Opscan service center.[1] Five categories of sites, each with different maintenance costs, are derived in the analysis. These categories and their eight year discounted maintenance costs, assuming three breakdowns per year, can be found in Table II-11.

Table II-11. Site Categories and Present Value Maintenance Costs for the Low Maintenance Case

Cost Elements (in 8 year present value)	Category 1 CONUS Sites 50 miles or less from Opscan Service	Category 2 CONUS Sites 51 to 89 miles from Opscan Service	Category 3 CONUS Sites 90 or more miles from Opscan Service	Category 4 Overseas Sites	Category 5 Ship Sites
Travel		$2,218			
Labor		1,259	$1,259	$1,259	$1,679
Parts		3,358	2,239	2,239	2,985
Total Maintenance	$5,373	6,835	3,498	3,498	4,664

(2) COMISAT Savings

The COMISAT savings which were considered in this analysis consist of student travel costs to and from the training centers, student living costs while training at the training centers, and training center terminals which would no longer be required. Travel cost is assessed differently for PCS students then for TDY students. The travel cost for a student attending training on TDY includes round trip travel from site to training center and meals required during travel time. One-way travel expenses from site to training center, plus meals during travel time, are required for a student attending training on PCS. Also, when a student on PCS travels to attend a course of under 140 days duration, he is permitted transfer of household effects at a cost of $291. This amount increases if the time is greater than 140 days.

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[1] See Appendix F.

Practically all travel cost is a function of the distance between the original station and the training center location. Since the exact mileage distribution is difficult to obtain, BUPERS uses an average distance of 1,500 miles for planning purposes. This factor is used here. The mileage data is combined with the current schedule of airline tariffs, obtained from the Civil Aeronautics Board (CAB).[1] Thus the one-way cost of a 1,500 mile trip, including tax, is $137. The total travel expense which could be saved if the entire student population could be trained at remote sites is $3,374,054 per year.

If COMISAT is employed, there is also a saving of $2.50 per calendar day of training for incremental living expenses which would not have to be spent at a training center. Thus the incremental living cost saved for the entire student population is $862,920 per year.

The total gross travel and living savings per year (TGS) for training at remote sites, as compared with CMI training at the training center, are

TGS = $4,236,974

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[1] See Appendix G.

or a present value over eight years of

$$TGS_{pv} = \$23,714,343.$$

The number of training center terminals needed would be reduced if some students were trained at their work site. One training center terminal is required for every 60 AOB students. Hence, there is a saving of one training center terminal for each 60 AOB students reached through COMISAT. A purchase price of $14,250 and a maintenance cost of $147 per month would be saved by eliminating a training center terminal, as found in Table II-7. As indicated earlier, the purchase option is the least expensive and is used to estimate the savings.

The COMISAT costs and savings for each category are utilized to determine a break-even site population.[1] The distribution of stuudents over Navy sites cannot be obtained; hence, it is assumed to be identical to the enlisted man distribution (Reference 7). A comparison of the break-even population for a category and each site population in that category determine which sites could be cost effectively developed for COMISAT. Sites with populations greater than the break-even value qualify.

c. Determination of Courses Justified by COMISAT Savings

The next step is to derive an estimate of the number of feasible courses, assuming the number of sites remains fixed at the level determined previously. To this end, the costs and savings due to COMISAT are reexamined.

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[1] See Appendix E.

Since only the feasible courses from the first 17 courses can be economically developed for CMI independently of COMISAT, the development and coding, course maintenance, computer leasing costs and the student time and living savings for these courses are not attributed to COMISAT. However, the development of any courses beyond the 17th would not be feasible without COMISAT, for these courses are justified only by savings achieved at remote sites. For this reason, the development, coding, course maintenance, computer leasing costs, and student time and living savings due to the use of CMI for the 18th and higher courses must be attributed to COMISAT.

One analytical concern should be noted for considering costs and savings associated with the 18th - Nth courses. As before, all cost elements are considered over an eight year period. It is also important to note that the annualized values not only represent costs and savings for the first eight years, but also apply to a program continuing beyond eight years.

Once a course is formatted for CMI at remote sites, it will also be used in this form at the training center to train students whose base is not outfitted with a terminal. Hence, COMISAT must be charged for the additional training center terminals required to teach the course. The total cost to COMISAT is the sum of the development and coding, course maintenance, computer leasing, training center terminal, and COMISAT terminal costs, as summarized in Table II-4. The savings credited to COMISAT include the travel and living costs for all courses, student time and incremental living savings for courses justified only by remote site savings, and training center terminal savings for the first 17 courses.

The net COMISAT cost expression which includes all of the above mentioned costs and savings is:

$$
\begin{array}{lll}
\text{Net COMISAT cost} & = & \left.\begin{array}{l}\text{Development and coding}\\ +\ \text{Course maintenance}\\ +\ \text{Computer leasing}\\ +\ \text{Training center terminals}\\ +\ \text{COMISAT terminals}\\ -\ \text{Travel and living}\\ -\ \text{Student time}\\ -\ \text{Incremental living}\end{array}\right\} \text{for courses justified by COMISAT savings} \\
 & & \left.\begin{array}{l}+\ \text{COMISAT terminal}\\ -\ \text{Travel and living}\\ -\ \text{Training center terminals}\end{array}\right\} \text{for courses justified by training center savings}
\end{array}
$$

This expression can be rewritten so that the only unknown factor is the number of courses which should be developed. Maximizing the net cost expression yields the optimum number of courses for CMI development.[1]

d. Determination of Additional COMISAT Sites

With the number of courses fixed at this new level, the feasible sites are again identified using a break-even population as previously described. The iteration between courses and sites is continued until the net savings changes by less than 5 percent from one cycle to the next. The results obtained by this procedure are discussed in Section B.

D. Conclusion

The analysis described here provides a necessary first assessment of the economics of the COMISAT concept. The methodology developed for the analysis can be used as the basis for more detailed analysis in the future as the COMISAT concept and its potential applications become better defined. A major step in that definition is confirmation of the operational feasibility of the concept by demonstration. Most important is the potential not only for savings in Navy training, but throughout the Department of Defense.

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[1] See Appendix E.

Chapter III

RESEARCH DESIGN

A. Introduction

As indicated earlier, the COMISAT project has eight objectives:

- To determine whether CMI delivered to remote sites produces the same learning effectiveness as CMI does in the learning center environment
- To determine whether the attitudes of students, trainers, and key remote site personnel are supportive of CMI delivered to remote sites
- To determine whether CMI delivered to remote sites is as economical as CMI in the learning center environment
- To determine the personnel requirements
- To determine the personnel training requirements
- To determine the organization and management structure requirements
- To determine the remote site space requirements and operational procedures for effective use of a CMI training support system
- To determine the equipment, maintenance, spare parts and logistics requirements

Achieving the first two objectives, concerned with learning effectiveness and the attitudes of students and key personnel, requires the use of statistical methods. For the remaining six objectives, the information and data gathered during the demonstration will be analyzed on a case study basis. The data related to the economic analysis, for example, will be used to check the assumptions made in the preceding chapter on the cost effectiveness of an operational COMISAT system. The information and data related to personnel, management, procedures, and logistics will represent only one of many situations to be found at Navy land bases and on ships. However, they can be used to infer operational requirements.

The following two sections present descriptions of the statistical methods to be used for assessing learning effectiveness and attitudes. Succeeding sections address the data gathering and analysis to be used for each of the six remaining objectives.

B. Statistical Design of the Assessment of Learning Effectiveness

1. General Statement of the Research Model

The general approach for this objective is an experimental/control group design where the learning effectiveness for a CMI program in an operational training environment will be systematically compared to learning effectiveness in the training center environment. The basic measure of effectiveness will be the time required to complete the CMI course. This measure is used because perfect scores are required to pass from one module to another and complete the course. Differences in learning are reflected only by the difference in the time it takes students to finish.

A second concern with regard to learning effectiveness is whether or not students taking the CMI course at the operational site learn more about electricity and electronics than students taking the existing BE/E correspondence course. To find out, volunteers from the outlying Stockton sites will be given the correspondence course. A special exam will then be prepared by PRC to test the basic knowledge of electricity and electronics of the students completing the CMI course and those completing the correspondence course. As a check on the validity of the special exam, it will also be given to E4 to E6 RMs with no formal training. If the test is conceptually valid, both the CMI and correspondence groups should score higher than those with no formal training.

An ideal experimental design addressing these issues would randomly assign subjects to the experimental and control groups from, respectively, personnel performing operational duties at Stockton and trainees at a training center. This is not possible at the operational site because:

- The program has to be voluntary
- Only RMs are available to participate
- The number of volunteers is small so that all have to be included in the experiment to meet parametric statistical assumptions

The fact that the experimental group will consist of volunteer enlisted RMs ranging from the E4 to E6 paygrades complicates the problem of selecting a control group. Since RMs are not required to take the BE/E course, none, or at most one or two, can be expected to be taking it at the time of the demonstration. Few are even expected to be found in historical records of the BE/E course. Therefore, it is necessary to select a basis for comparison other than the same rating.

It was decided that the basis for obtaining comparable control groups would have to be the paygrade level rather than the RM rating. Here it was reasoned that the next best thing to having a control group of the same rating would be to have the control group consist of personnel with roughly equivalent experience. The basis for this selection is that motivation and ability are highly correlated with experience. This still does not permit using current trainees at the schoolhouse, because BE/E is an A-School course with few trainees of the higher paygrade levels. However, there are expected to be enough historical records of trainees at the E4 to E6 level to obtain a control group.

The experimental design for assessing learning effectiveness will therefore compare the time to complete the CMI course by RMs at Stockton to the performance of trainees with similar paygrades in the historical records of the CMI course at a training center. In addition, the performance of CMI graduates from Stockton on a general electricity and electronics exam will be compared to the performance of Stockton personnel who complete the correspondence course. The design is shown in Figure III-1.

2. Research Hypotheses

From the first objective it is hypothesized that:

> The total training hours required for experimental subjects to complete the BE/E CMI course requirements will be less than or equal to the training hours required for training center subjects to complete BE/E course requirements.

Statistically it is necessary to test this hypothesis by first determining if the following null hypothesis, H_o, can be rejected and one of the alternatives, H_1 or H_2, accepted:

$$H_o: a = b$$

$$H_1: a > b$$

$$H_2: a < b$$

where a is the mean time to completion of the experimental group and b is the mean time to completion of the control group. If H_o is rejected, then the value of the means will determine if H_1 or H_2 is

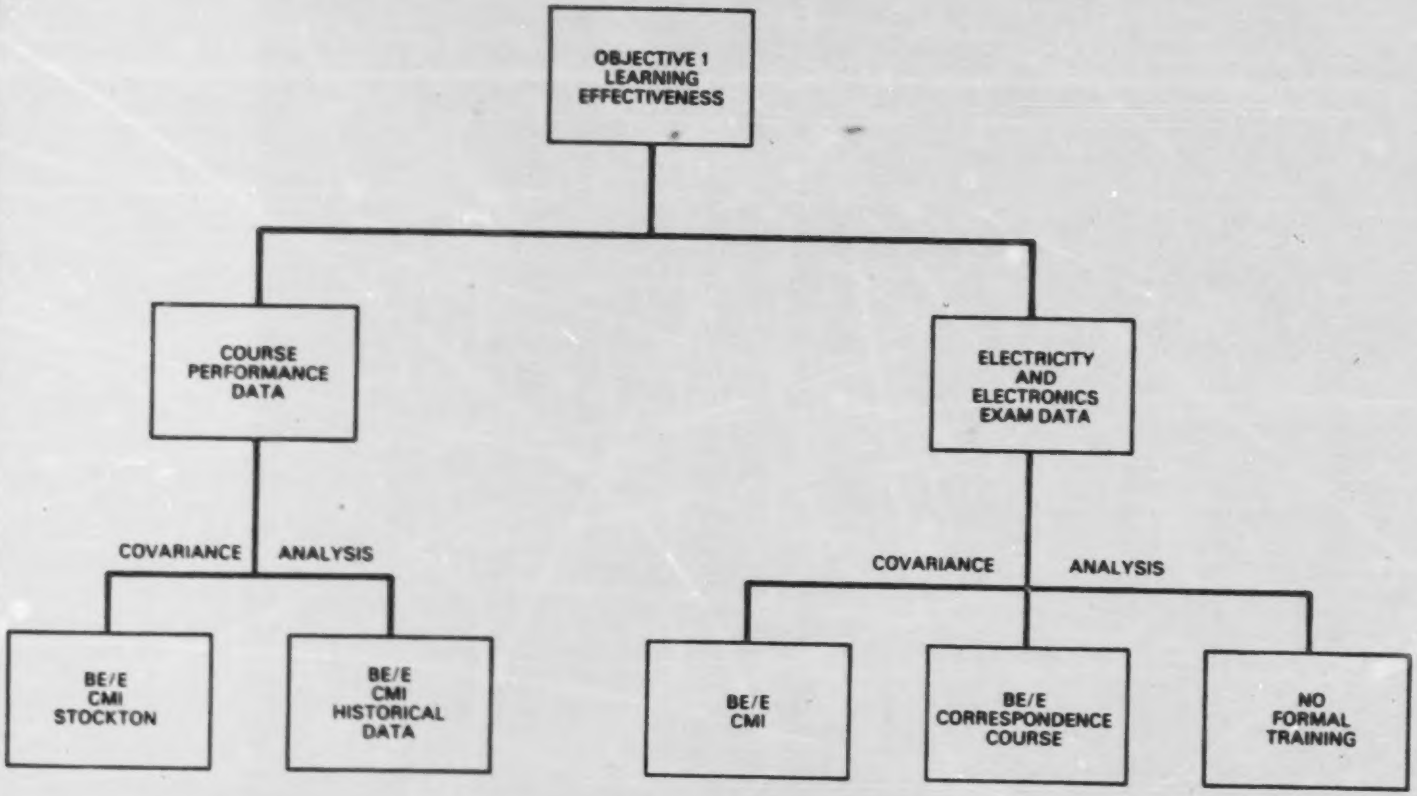

Figure III-1. Research Design For Learning Effectiveness Analyses

to be accepted. Should H_o not be rejected, the probability of H_o being false will be determined.

It is also hypothesized that:

> The CMI BE/E training group will perform better on a special electricity and electronics examination than will the correspondence training group.

Stated symbolically:

$$H_o : a = b$$

$$H_1 : a > b$$

The null hypothesis, H_o, assumes no effects due to differences in training methods, and the alternative hypothesis, H_1, predicts that the score, a, of the CMI BE/E group will be higher on a special electricity and electronics exam than the scores, b, of the correspondence group.

As a check on the validity of the special exam, the scores of the CMI and correspondence groups will be compared to those of a group of E4 to E6 RMs with no formal BE/E training. Formally stated, it is hypothesized that:

> Both the CMI and correspondence course graduates will achieve higher scores on the special electricity and electronics exam than the personnel with no formal BE/E training.

The symbolic representation is:

$$H_o : a = b = c$$

$$H_1 : a > c$$

$$H_2 : b > c$$

The null hypothesis assumes that neither of the two training programs has an effect. The alternative hypotheses H_1 and H_2 predict that the scores *a* and *b* of the CMI and correspondence groups will be greater than the scores *c* of the group with no formal training. If H_1 or H_2 is not confirmed, further study would be required to determine if no learning occurred due to CMI or correspondence, or if the exam itself was poorly designed.

3. Definition of Research Variables

The independent variables are the location of the training and the method of training. The location of training is the more important concern, since determining the differences in learning effectiveness, if any, between the CMI course at the remote site and at a training center is the major objective of the COMISAT project. The methods of training investigated in this project are the CMI and correspondence courses.

The dependent variable for determining the effect of location on CMI performance is the total amount of time required to reach criterion on Modules 1-14 of the BE/E course. This includes all of the students' time spent studying, doing laboratory experiments, and taking performance and knowledge tests for each module. The variable is expressed in total hours spent for the course.

The dependent variable for determining the difference in effectiveness between CMI and the correspondence course training methods is the score on a specially designed test which measures knowledge of electricity and electronics materials contained in both the CMI BE/E course (Reference 10), and the correspondence course manual, Chapters 1-15 (Reference 11). The test will draw from material common to both the CMI and correspondence materials.

The *covariate* or *intervening variables* are used to adjust the values of the dependent variables to account for initial differences between the people whose performance is being measured. For example, the CMI students at Stockton might have consistently different Basic Test Battery (BTB) scores than the training center control group. The BTB is given to each enlistee, and is a standard Navy aptitude measure used in part in assigning enlistees to ratings. If the BTBs are different, then a difference in CMI performance can be expected. The covariance analysis statistically matches groups so that the differences due to location of the training can be assessed.

The BTB scores will be used as the covariate in comparing learning effectiveness at the site to that at the training center. The scores have been shown to be negatively correlated with the measure of performance in the course; i.e., people with higher BTB scores take less time to complete the course. Because of significant correlations, BTB scores are presently used as the basis for predicting the completion time for each CMI student. The predictions are used by the LS in monitoring student progress.

Both BTB and diagnostic reading scores will be used as covariates in comparing student performance on CMI to correspondence student performance. Again, previous evidence shows a correlation between this ability and success in training. This correlation was particularly significant in electricity and electronics training.

4. Statistical Models

One-way analysis of covariance statistics will be used to test these hypotheses. Symbolically, the model is as follows:

$$y_{ij} = \mu + \tau_i + \beta(x_{ij} - \overline{x}_{..}) + \epsilon_{ij} \quad \begin{cases} i = 1,2,\ldots,a \\ j = 1,2,\ldots,n \end{cases}$$

where y_{ij} = the jth observation on the dependent measure, e.g., total time to complete BE/E course, under the ith treatment, e.g., experimental or control site;

x_{ij} = the covariate variable(s), e.g., Basic Test Battery score, corresponding to y_{ij};

$\bar{x}_{..}$ = the mean of x_{ij} scores;

μ = the overall mean;

τ_i = the effect of the ith treatment;

β = a linear regression coefficient showing dependency of y_{ij} on x_{ij};

ϵ_{ij} = the random error component;

The model assumes that:

- Errors ϵ_{ij} are normal and independently distributed,
- $\beta = 0$ and the relationship between y_{ij} and x_{ij} is linear
- Regression coefficients for treatments are identical
- Treatment effects sum to zero
- The covariate is not affected by the treatment

The F statistic is used to test $H_o : \tau_i = 0$

$$F_o = \frac{(SS'_E - SS_E)/(a - 1)}{SS_E/\ a(n-1) - 1}$$

where SS_E = error sum of squares;

SS'_E = reduced sum of squares for error;

$(SS'_E - SS_E)$ = the reduction in sums of squares in order to test the hypothesis of no treatment effects;

a = the number of treatment (experimental) groups;

n = the number of subjects per group.

The null hypothesis will be rejected if $F_o > F_\alpha$.
The alpha level or level of confidence for statistical tests is set at $p < .05$.

It should be noted that for the second hypothesis, i.e., determining the effects of CMI and correspondence training methods on learning electricity and electronics material, it may not be possible to use the covariance analysis because of the small number of participants anticipated in the correspondence course. Should the sample size fall below 20, it may be necessary to use an equivalent nonparametric statistic. The appropriate model for this situation is the Kruskal-Wallis one-way analysis of variance by ranks statistic. Stated symbolically:

$$H = \frac{12}{N(N+1)} \sum_{j=1}^{k} \frac{R_j^2}{n_j} - 3(N+1)$$

where k = number of samples
n_j = number of cases in jth sample
$N = \sum n_j$ the number of cases in all samples combined
R_j = sum of ranks in jth sample (column)

The H statistic is used to test the hypothesis and, with a sample greater than five, is distributed approximately as chi square with k - 1 degrees of freedom.

5. Data Collection, Organization and Analysis

a. Input

At the conclusion of the demonstration all data will be transferred from data tally sheets to punched cards for the analysis. Appendix H contains a sample data tally sheet and shows the data format for the punched cards.

The BTB data will be recorded on data tally sheets by PRC staff with the assistance of the ESO during the week of September 12. The reading ability scores will be recorded on tally sheets by October 21. The last data input will be the CMI course performance, correspondence course performance, and performance on the electricity and electronics special exam. These will have been collected by March 10, 1978.

An added requirement for the Kruskal-Wallis analysis is that the data must be arranged as n cases of two variables, where n is the number of subjects. One variable is the test score; the other is an identifier which indicates whether the subject is in the CMI, correspondence, or no-formal-training group. The input format for these data is also shown in the sample punched card in Appendix H.

b. Computational Steps

The computational steps for the covariance analysis are quite lengthy. The reader can find a discussion of the procedures for one-way analysis of covariance in Reference 12. For the Kruskal-Wallis analysis computation the procedure is far less complicated. The reader is again referred to Reference 12 for the specific computational procedures.

c. Output and Interpretation of Results

The computer output for the covariance analysis includes a number of important items. These are:

- Regression coefficients, their standard errors and t values
- Group means, adjusted group means, and standard errors of adjusted group means
- Analysis of variance table with F test for equality of adjusted group means, zero slope, equality of slope, and the tail area probability

- Pair wise t test for adjusted group means and t test for contrasts of adjusted group means
- Regression coefficients for each covariate in each group

Proper interpretation of these results requires that a sequence of steps be followed:

- The regression coefficients should be the same for treatments in each of the CMI, correspondence, and, where appropriate, no-formal-training groups. If they are not, the relationship between the selected covariate and the dependent variable is different for each group being measured. Another covariate would have to be found which does not have a different relationship for each group, data obtained for the new covariate, and the analysis repeated until a satisfactory covariate is identified.
- The F test of the equality of slopes should be checked to confirm that the regression lines for the three groups have the same slope. If the slopes are significantly different, the covariance analysis is not appropriate and analysis of variance would be substituted.
- For the first hypothesis concerning course performance the F test for the equality of adjusted group mean is the most important result from the output. Provided the previous assumptions have been met, a significant F ratio will indicate that the two training environments produced course performance results that were significantly different from each other. The more effective training environment will have a lower adjusted group mean indicating less time required to reach criterion.
- If covariance is used to determine the effects of different training methods, then a significant F ratio would require checking t ratios since there would be three, rather than two, groups involved. Checking the t ratios becomes necessary in this case because a significant F ratio does not indicate which group means are significantly different from each other, it only indicates that there is a difference. The t test will show the ordering of the three training methods in terms of test performance and the level of significance. The level of significance of the difference in performance between the CMI and correspondence groups should also be assessed by conducting an F test of these two groups without considering the control group.

The output for the Kruskal-Wallis test statistic is less complicated and includes the items listed below:

- Test statistic H
- Level of significance or probability of occurrence

Samples of the printout for each of these analyses are provided in Reference 12.

If the Kruskal-Wallis analysis is used for the second hypothesis test of the relative effectiveness of training methods, the H statistic is interpreted in the same manner as the F statistic but by using the chi square distribution rather than the F distribution. A significant H will be interpreted as confirmation of the alternative hypothesis, i.e., that CMI is better than correspondence or no formal training, if the group mean differences are in the predicted direction. A significant H test with the 'no formal training' group in the analysis would lead to a recommendation that additional analysis be conducted without the control group. This analysis would provide a direct assessment relative to a treatment effect due to CMI training versus correspondence training.

C. Definitions and Procedures for the Attitude Objective

1. General Statement of the Research Model

For this objective attitude measures will be compared between operational site students and a comparable group of individuals taking a CMI course at training center facilities. A comparison of attitudes will also be made between the LS at the site and LSs at the training centers. A third concern is to assess the attitudes of key Stockton operational personnel towards CMI.

Semantic differential scales have been designed to measure attitudes toward a number of CMI dimensions. These include CMI as a concept, course material, the LS as viewed by the students, the students as viewed by the LS, testing procedures, and test feedback in terms of content and response time. A pretest-posttest approach will be followed in collecting the data.

Statistical methods can be used in comparing experimental and control student groups. For the LS and key personnel at Stockton, however, comparative analysis of attitudes will not be possible. In the case of the LS, it will be possible to test several LSs at the training center. This information can only be used as a guide in searching for conditions at Stockton that strongly affect the LS's attitudes towards the delivery of CMI at a remote site. No comparison will be possible for the attitudes of key Stockton personnel. However, the attitude test results will be useful in determining the conditions most affecting their attitudes.

The following subsections describe the analysis of student attitude data. The final subsection briefly discusses criteria for assessing LS and key personnel attitudes.

a. Demonstration Groups

The experimental student group for the attitude study will be the CMI students at Stockton. Since the control group for the learning effectiveness analysis is drawn from historical records, it cannot be used in the attitude study. A separate control group is needed.

The objective is to determine attitudes toward CMI as a delivery system rather than the specific course. Therefore, although it is possible to find subjects in any CMI course at any training center, the important factor is that they be similar to the experimental subjects with respect to length and level of service experience. That is best represented by pay grade. The reasoning behind this choice is that people with the same length of service experience would be more likely to have similar motivation and reactions to learning conditions.

In order to adjust for differences not eliminated by the use of equivalent pay grades in the control group, covariance analysis will be used in evaluating attitudes. Based on previous research with semantic differential instruments, pretest measures have been shown to be a good means of adjusting posttest measures to account for initial differences between the experimental and control groups (Reference 13).

Although any training center is a candidate for providing attitude control groups, it is expected that Memphis will be the choice. The only factor that can change this is the possibility that not enough students at the required pay grades will be found at the one school.

b. Validation Groups

Prior to demonstration data collection, a conceptual and statistical validation of the student attitude instrument is necessary. A sample of at least 110 subjects will be needed. The BE/E schools at Great Lakes and Memphis appear to have the most representative sample of BE/E CMI students and will therefore be used for the validation study.

The validation study will use factor analysis to reduce the number of variables used in testing attitudes toward each CMI component. The resulting version of the test will be more accurate and conceptually valid. Figure III-2 shows the design approach, including validation, for the attitude objective.

2. Research Hypothesis

It is hypothesized that:

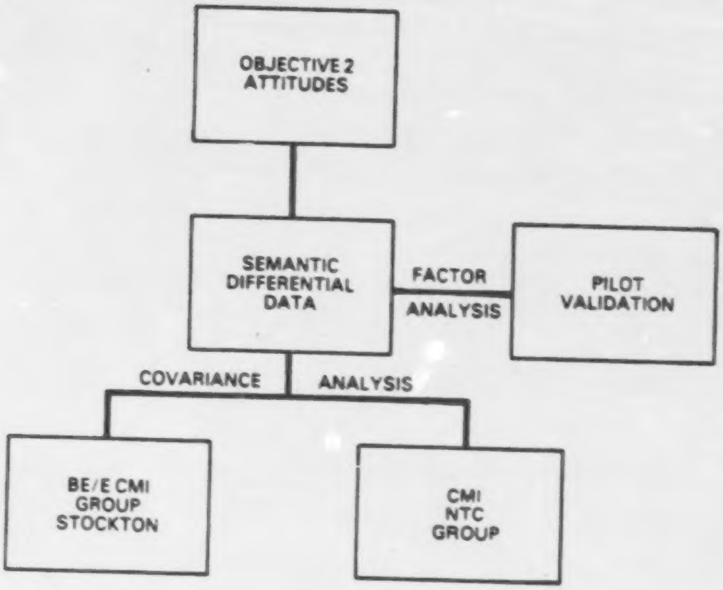

Figure III-2. Research Design For CMI Attitude Analyses

Attitudes toward CMI concepts for key site personnel and trainees as measured by semantic differential scores will be equal to or more supportive than attitudes of trainees.

Stated symbolically:

$H_o : a = b$
$H_1 : a > b$
$H_2 : a < b$

where the null hypothesis, H_o, assumes no attitude effect due to the different training sites, and the alternative hypothesis, H_1, predicts that training in the operational context will produce attitudes toward the CMI concept more supportive than at the traditional training center. If H_o is rejected, the mean scores will be examined to determine if training at the operational site is more desirable than at the schoolhouse or vice versa.

3. Definition of Variables

The training site is the major independent variable for attitude measures. The experimental site has already been defined as the operational training site at NAVCOMMSTA Stockton. The control site(s) will be one or more training center facilities with CMI.

The dependent variables will be attitudes toward the CMI components addressed by the semantic differential scales. The semantic differentials were developed with bipolar adjectives considered relevant to that concept. As an example, the bipolar adjectives considered relevant to the CMI concept are shown in Figure III-3. The complete instrument addressing this and the other components is presented in Appendix I.

As indicated earlier, pretest attitude scores will serve as the covariate for each analysis.

4. Instrument Validation.

As indicated above, the statistical validation of the attitude instrument requires appropriate factor analytic techniques. The basic statistical model for this validation stated symbolically is:

$$z_j = a_{j1}F_1 + a_{j2}F_2 + \ldots + a_{jn}F_n$$

where z_j = variable j in standardized form, described linearly in terms of F_n and a_{jn}

Computer Managed Instruction (CMI)

like	7	6	5	4	3	2	1	dislike
valuable	7	6	5	4	3	2	1	worthless
adequate	7	6	5	4	3	2	1	inadequate
meaningless	1	2	3	4	5	6	7	meaningful
interesting	7	6	5	4	3	2	1	boring
frustrating	1	2	3	4	5	6	7	motivating
good	7	6	5	4	3	2	1	bad
unorganized	1	2	3	4	5	6	7	organized
disapprove	1	2	3	4	5	6	7	approve
useless	1	2	3	4	5	6	7	useful

Figure III-3. Semantic Differential Instrument: CMI Concept

F_n = new uncorrelated components

a_{jn} = standardized regression coefficients

Factor analysis is used to insure measurement reliability and conceptual validity by removing unnecessary measurement overlap. Essentially, the procedure will allow us to determine which adjectives in the semantic differentials are intercorrelated. The major objective of the analysis is to arrive at simplified subjective measures for each of the concepts in the study. In the present case, these measures derive from a subject's response to the semantic differential instrument (see Figure III-3). The result of the factor analysis is a smaller number of bipolar adjectives being abstracted from the larger instrument. The adjectives which are abstracted from the larger set represent the various ways that respondents interpret each concept. In response to the survey, those adjectives which are correlated with each other or are used in a similiar fashion by subjects are said to represent a factor. A factor is a theoretical construct which is assumed to characterize one dimension of a survey or test. In education, for example, verbal ability is thought to be one of several factors underlying intelligence.

As shown in Figure III-4, the data indicate that one of the factors underlying the CMI concept has five bipolar adjective measures. These adjectives all have relatively high factor loadings (between .69 and .84) under Factor I and relatively low loadings under each of the other factors in the matrix. All five adjectives would serve as a valid measure of Factor I. Since these adjectives represent attitudes as opposed to other factors in the matrix, Factor I has been labeled "attitude." Theoretically, scores from any one of the five could serve as the attitude measure. However, greater measurement reliability is obtained by summing scores from all five adjectives. Based on adjectives with high factor loadings, our hypothetical example yields three other factors which we have arbitrarily labeled: "adequacy of the system," Factor II; "system meaningfulness," Factor III; and "system appeal," Factor IV. Since our primary interest in this study is the measurement of attitudes toward the CMI concept as included in Factor I, only those five adjectives would be used in the analysis. The revised version of the CMI concept test based on the factor loadings is shown in Figure III-5.

For the pilot validation the principle factors technique followed by an orthogonal rotation to simple structure with the varimax criterion will be used. An eigenvalue of 1.0 or greater will be used as criterion for terminating factor extraction in the rotation procedure (see Reference 14). In the present case, the factor analysis is performed on the n x n correlation matrix formed from each set of semantic differential scales. Essentially, the factor analysis identifies clusters of adjectives from the correlation matrix which are

Factor / Variable	I	II	III	IV
Like-dislike	.81*	.11	.09	.13
valuable-worthless	.78*	.05	.19	.03
adequate-inadequate	.12	.68	.28	.04
meaningless-meaningful	.07	.21	.65	.06
interesting-boring	.02	.14	.09	.79
frustrating-motivating	.01	.27	.04	.29
good-bad	.84*	.10	.01	.16
unorganized-organized	.14	.23	.82	.14
disapprove-approve	.69*	.23	.08	.13
useless-useful	.73*	.18	.11	.01

*These variables loaded highly under one factor (Factor I) and were relatively pure; i.e., had relatively low loading on all other factors. They would therefore be used as the attitude measure for the CMI concept.

Figure III-4. Hypothetical Rotated Factor Matrix for the Computer Managed Instruction Semantic Differential Instrument

Computer Managed Instruction (CMI)

like ______ : ______ : ______ : ______ : ______ : ______ : ______ dislike
valuable ______ : ______ : ______ : ______ : ______ : ______ : ______ worthless
good ______ : ______ : ______ : ______ : ______ : ______ : ______ bad
disapprove ______ : ______ : ______ : ______ : ______ : ______ : ______ approve
useless ______ : ______ : ______ : ______ : ______ : ______ : ______ useful

Figure III-5. Semantic Differential Test: CMI Concept

intercorrelated and bear a relation to one or more factors. This analysis results in a factor matrix containing factor loadings. Factor loadings are basically an indication of the degree of relation between a bipolar adjective measure and the factors. From the raw factor matrix an orthogonal rotation is performed so that the clusters of adjectives can be arbitrarily placed in the most meaningful psychological array. This rotation yields the factor matrix depicted in Figure III-4. In this example the eignevalue criterion reduced the number of meaningful factors in the rotated matrix to four. Other factors are dropped from the matrix because they account for virtually none of the variance in the survey.

The criterion for acceptance of an item in the factor structure will be set at a factor loading of .60 or better on one factor and .30 or less on any other factor in the matrix. While not anticipated, some modification of this criterion may be necessary depending on the outcome of the rotated factor matrix. (Some researchers use less stringent criteria for placing a scale into a given factor in the matrix, such as .50 and .40 instead of .60 and .30 respectively.)

Once the instrument has been validated, a one-way analysis of covariance will be used for the demonstration data. The covariance model for the attitude analysis is the same as that for the course performance analyses.

References 14 and 15 are recommended for an in-depth discussion of factor analysis theory and application.

5. Data Collection, Organization, and Analysis of Student Attitudes

a. Input

At the conclusion of the demonstration all data will be transferred from the data tally sheets to punched cards for analysis as shown in Appendix H. Pretest attitude data at experimental and control sites will be collected and tabulated by PRC staff with the assistance of the ESO during the week of August 18. In the case of the control subjects, pretest data collection may be at more than one site as designated. This data collection will be done by PRC staff with assistance from designated personnel at the control group sites. Posttest attitudes will be collected and tabulated by PRC staff with assistance from the ESO and designated assistants at the conclusion of each student's course. It is estimated that the last student will finish during the last week of February.

b. Computations and Results

The covariance analysis will be similar in form to that described for evaluation of course performance data. A nonsignificant F ratio, or a significant F ratio in favor of experimental group attitudes, will confirm the hypothesis that student attitudes at the remote site are supportive of CMI.

6. LS and Key Personnel Attitudes

The student-validated instrument will be used to assess the attitudes of the LS and key Stockton personnel. As indicated earlier, the LS's attitudes towards CMI delivery at remote sites will be compared to the attitudes of LSs at the training centers. The LSs of the control group students will be given the pretest-posttest combination. This will probably involve no more than six to 10 subjects.

The attitudes expressed by the Stockton LS will be compared to the mean scores of the training center LSs. Areas of differences will be explored to find out what conditions most affect the LS's attitude. This information will be supplemented by interview data obtained in support of the personnel, personnel training, facilities, procedures, and logistics objectives of the demonstration. The interviews are described in later sections of this chapter.

Key personnel attitudes will also have to be examined for indications of major concerns. In this case there will be no comparative information to guide the assessment (as there is with the LS). The relative measures from the tests, and the change in those measures, will provide useful information. Additional understanding of areas of satisfaction and dissatisfaction will be obtained from the interview responses gathered for the other objectives.

For both the LS at Stockton and the key Stockton personnel, a score of 4.00 or higher on any aspect of the CMI system will be regarded as favorable since it is above the hypothetical mean. That finding would confirm the hypothesis that key personnel will be supportive of CMI delivered to remote sites. In addition, the assessment of major factors influencing attitudes can lead to recommendations for an improved delivery system design.

D. Economic Evaluation

1. Data Gathering Objectives

The purpose of the economic evaluation is to obtain improved estimates on operational costs for the COMISAT concept. Those estimates would permit updating the analysis of Chapter II to obtain a more accurate projection of net savings to the Navy attainable through a fully operational remote-site CMI network. The specific data gathering objectives of this evaluation are as follows:

- To determine all costs of procuring, installing, maintaining, and operating the communication system required for the CMI demonstration. This will require data on the reliability and maintenance of the terminals, particularly the Opscan, and on the reliability of the communication link.

- To determine the equipment and materials (including expendables) required to keep the CMI course in operation.
- To determine the amount of additional personnel hours expended on activities connected with the CMI demonstration objectives by:
  - -- Each student
  - -- The LS
  - -- The ETs
  - -- Watch supervisors
  - -- The ESO
  - -- Division Training Chiefs/Petty Officers (DTC/POs)
  - -- Division Officers
  - -- Communications Officer
  - -- CMI advisor
  - -- Other staff
- To determine the equivalent costs of operating the correspondence course:
  - -- Student hours required
  - -- Cost of materials
  - -- Cost of mail
  - -- Remote site personnel hours required

This information, along with the assessment of correspondence course effectiveness, will be used to compare CMI and correspondence as a means of reducing Navy training costs.

2. Data Gathering Procedures

a. Communication System Cost

At the end of the demonstration, MIISA Memphis will provide PRC with a complete cost breakdown of the communication system. The required data are as follows:

- Lease, including installation and maintenance, of two Opscan/Terminet clusters
- Lease, including installation and maintenance, of a commercial dedicated line from Stockton to San Diego, including a Bell 202-T modem at each end of the line

- Lease, including installation and maintenance, of an RP6352 asynchronous line modulator to connect the phone line to the CMI concentrator at San Diego

These data will be collected and mailed to PRC in McLean, arriving by March 10, 1978.

As part of the assessment of communication system costs, the data collection system will measure the system's reliability and maintenance requirements in the following way:

- When either the Opscan or Terminet malfunctions, the LS or ET enters into the maintenance log (see Appendix J):

  -- Identification of the equipment
  -- The time at which the failure was first noticed
  -- The time the contractor is called
  -- The nature of the malfunction

  On arrival, the maintenance technician enters the time. When the work is complete and the equipment back in operation the time is entered in the log and the nature of the problem and the correction are described.

- Down time resulting from problems with the communication link, the CMI concentrator in San Diego, or the CMI computer in Memphis, will be recorded by the LS or ET. If not immediately known, the LS or ET will determine the cause by contacting MIISA San Diego or Memphis and recording it in the maintenance log.

On the first day of each month the LS will send a copy of the maintenance log to PRC in McLean, Virginia.

b. Personnel Resources

(1) Student Course Time

Each student in both the CMI course as well as the correspondence course will be issued a time card as shown in Appendix I. A complete chronological history of time spent in study (on and off watch), lab, performance test, and knowledge test will be kept. The

CMI students will have their time stored in the computer. For them the card is a reference from which corrections can be made if there are errors in the computer entries. The LS will make any corrections that are needed. Final data on the total course time will be provided to PRC by MIISA by February 28.

(2) LS Time

Time spent by the LS and the type of activity will be recorded in the log described in Appendix J. The data to be recorded each day are:

- Date
- Hours devoted to counseling the students on course content problems
- Hours devoted to administrative functions, e.g., maintaining student files, answering procedural questions, and coordinating activities with Fleet Center operations

(3) ET Time

When the ETs act as resource persons in the absence of the LS, their time is to be kept on a log identical to the LS form. The entries would be made in the Substantive Activities section. Administrative activities will be entered separately.

The ET lab equipment maintenance time will be recorded in the same manner that the log is kept for Opscan/Terminet maintenance.

(4) Other Personnel

ESO, Communications Officer, Division Officers, DTC/POs and CMI advisor will each maintain a key personnel log. When staff of the Fleet Center perform duties on the demonstration, the Division Officers will indicate in their logs the type and duration of the activity, and the position of the person doing it. If an individual not assigned a log is found to contribute a significant amount of time to the demonstration, that person will be assigned a log of his or her own.

c. Equipment and Materials

The concern here is to determine the amount and cost of lab equipment, microfiche readers, microfiche test cards, texts, answer sheets, administrative forms (P1, P2, P3), Terminet paper, and expendables required per student. The BE/E Training Program Coordinator (TPC) at CNTECHTRA will provide PRC at McLean with an itemized cost of each shipment.

It will be important to know if the shipments adequately support the operation. Therefore, the LS and ETs will note in their logs any instances where equipment or materials are not available to a student.

d. Correspondence Course Costs

The following data gathering will take place during the demonstration:

- The correspondence course student time data will be maintained by the ESO at Stockton. Each Friday each student is to give his or her weekly card to the DTC/PO to be sent by Navy mail back to the ESO at headquarters. Once a week, the ESO will send a summary of student progress to PRC at McLean and give a copy to PRC staff on site, if any, showing
  - Each student's name
  - Lessons completed
  - Lesson being worked
  - Total time in the course to date

  The format is shown in Appendix J.
- The ESO's time spent on correspondence will be recorded separately in his log.

- The DTC/POs at the outlying sites will maintain a key personnel log, entering their time under the Administrative Activity heading. The ESO is to receive the logs by base mail each Monday, and copies are to be sent to PRC at McLean along with the CMI personnel logs.
- Estimates will be sought, based on correspondence course experience, for the cost of texts, tests, answer sheets, and mailing materials back and forth between the site and the correspondence center. The estimates will be obtained from the Naval Education and Training Program Development Center, Pensacola, Florida.

3. Analysis and Results

The data obtained for the economic evaluation will be used in recalculating the cost impact of the COMISAT project with the procedure described in Chapter II. The communication line and modem costs for the commercial leased line will serve only as a guide to cost and reliability problems. If COMISAT goes operational it will use AUTODIN II and therefore would not incur commercial modem equipment and leased line costs. All the other data on terminals, equipment, materials, and personnel will be used to determine potential costs and savings of an operational system.

E. Personnel Requirements

This objective is concerned with determining the tasks that have to be performed by onsite personnel and the level of effort required in order to support an effective CMI program. The personnel of interest are the LS, ETs, DTC/POs, ESO, Division Officers, and the Communications Officer.

The information and data needed to achieve this objective come from three sources:

- PRC staff will observe operations continuously over the first two weeks of the demonstration, and then for one week intervals at the beginning of the second month of the demonstration, and once a month thereafter.

- PRC staff will interview students and key personnel at the end of the first two weeks, the end of the first month, and then once a month until the end of the demonstration. The interview instrument described in Appendix K will be used.
- Key personnel time logs will be reviewed each week as they are received by PRC from the ESO.

Based on this information, recommendations for changes will be developed as needed, implemented after approval by the Communications Officer or Division Officer, and monitored. At the end of the demonstration, guidelines will be prepared for the number and type of personnel assigned to an operational CMI system and their tasks.

F. Personnel Training Requirements

This objective is concerned with determining the training needed for site staff supporting CMI courses. An assessment will be made of the time and activities in the demonstration that might appropriately be classified as training for the supporting personnel. This will include the preparation of the LS and the time spent by the CMI advisor in dealing with support personnel. Inadequacies and effective elements of the training will both be identified, and recommendations made for training to support an operational CMI system.

The demonstration has been set up so that the LS will receive BE/E Instructor training, and the LS and CMI advisor will train the watch supervisors and ETs to carry out their responsibilities. Time spent by the LS and CMI advisor with the watch supervisors and ETs will count towards training. To gather this data the LS and CMI advisor will maintain logs from their time of arrival at Stockton. They will record the particular activity and time spent in training the others, including all staff orientation sessions and walkthroughs. Copies of the logs will be submitted to PRC via the ESO at the end of the preparation stage and on a weekly basis during the demonstration.

The information from the logs will be supplemented with information from the observation of procedures and the periodic interviews (Appendix K) by the PRC staff.

At the end of the demonstration the following information and data will be obtained:

- A summary of training time for all personnel
- Problems of inadequate training and areas of satisfaction will be identified

From this an assessment will be made of the adequacy of the CMI advisor's role and the need for more formal key personnel training programs. Recommendations will be made on the amount and type of training, and the role of the CMI advisor in setting up a new activity.

G. Organization and Management

This objective is concerned with determining the organization and management structure needed for successful operation of onsite CMI courses. There are three considerations:

- The existing structure at a base or on board ship
- The structure needed to support CMI
- The degree to which the two can accommodate each other

In this demonstration the command structure for the Fleet Center at Stockton is shown (Figure III-6), with the position of the LS indicated. As the demonstration progresses, changes will be made in these organization and management structures to eliminate or at least alleviate problems. It will be necessary to monitor those changes. By understanding why the changes were made and how well the final system functions, inferences can be drawn on the organization and management structure needed for operational use of CMI.

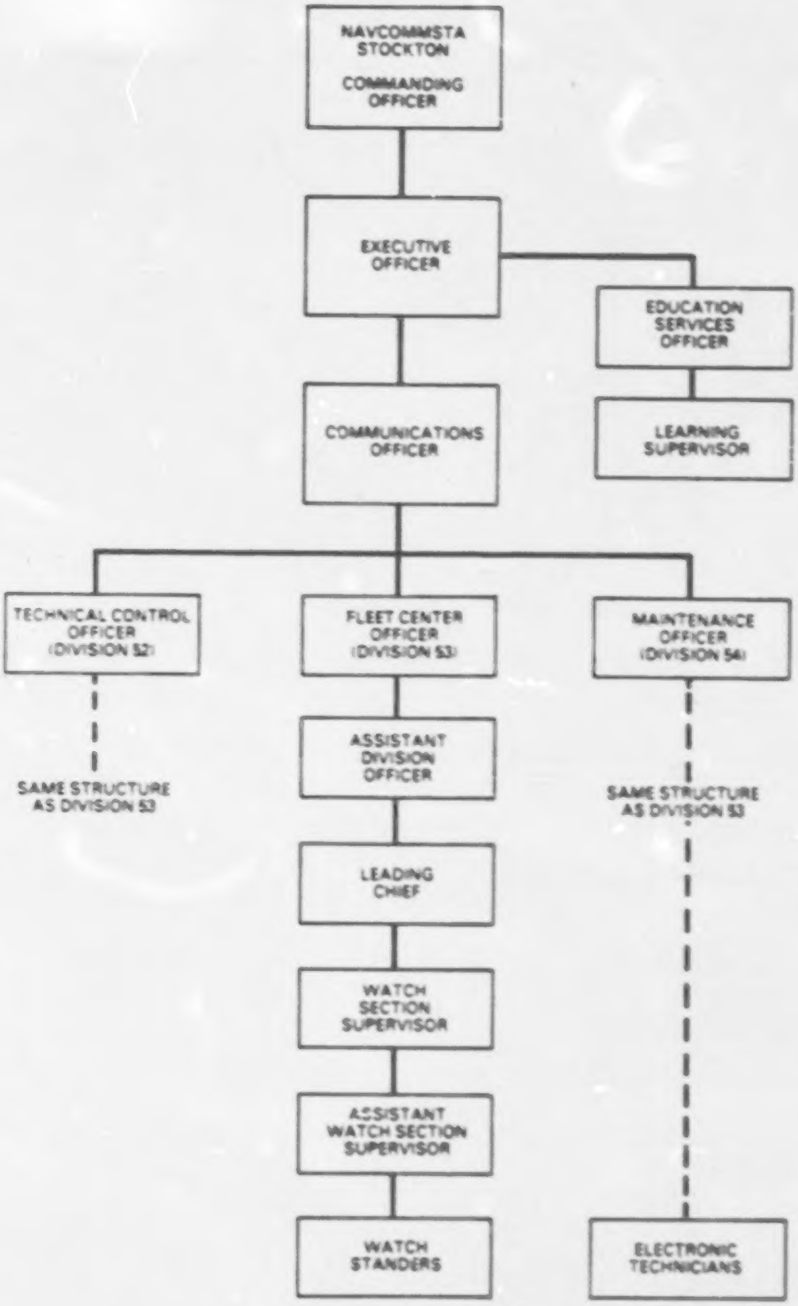
NAVCOMMSTA STOCKTON
COMMANDING OFFICER
EXECUTIVE OFFICER
EDUCATION SERVICES OFFICER
LEARNING SUPERVISOR
COMMUNICATIONS OFFICER
TECHNICAL CONTROL OFFICER (DIVISION 52)
FLEET CENTER OFFICER (DIVISION 53)
MAINTENANCE OFFICER (DIVISION 54)
SAME STRUCTURE AS DIVISION 53
ASSISTANT DIVISION OFFICER
SAME STRUCTURE AS DIVISION 53
LEADING CHIEF
WATCH SECTION SUPERVISOR
ASSISTANT WATCH SECTION SUPERVISOR
WATCH STANDERS
ELECTRONIC TECHNICIANS

Figure III-6. NAVCOMMSTA Stockton Organization

The personnel time data and activity descriptions entered in the key personnel logs will show what is required to operate CMI, and how it can interfere with routine operations. Additional insight into why different elements of the CMI organization and management system are desirable or not desirable will be obtained from PRC observations and interviews of key personnel and students using the package from Appendix K. Specifically, individual opinions will be sought with regard to:

- Lines of authority and the level at which decisions are made on CMI procedures
- Degree of participation in decisionmaking by each of the key personnel
- Flow of information up through the chain of command to keep decisionmakers apprised of the status of the demonstration and of problems needing resolution
- Flow of information to personnel responsible for carrying out the decisions
- Speed at which problems are identified, decisions made, and solutions implemented

The information sought will vary with the level of authority. The following people will be asked to submit to interviews on these issues:

- Commanding Officer, NAVCOMMSTA Stockton
- Communications Officer
- Division Officer
- Radioman watch supervisors, Leading Chiefs, Chiefs of the watch
- ESO
- DTC/POs
- ETs
- LS

- CMI advisor
- Students

The base commanding officer, the Communications Officer, the Division Officers, leading chiefs, chief of the watch, and watch supervisors will be interviewed to determine their level of satisfaction, and specific problems and suggested solutions concerning:

- The reporting to them of the status of the demonstration status and any problems
- The workload imposed on their staff by the CMI program
- The degradation, if any, of normal station operations
- The speed at which decisions to change the CMI operation are implemented
- Any other problems they encounter

The ESO, DTC/POs, LS, and CMI advisor will be interviewed concerning:

- Their ability to raise problems or opportunities for change and receive approval
- The priority given CMI matters in general
- The amount of time given to prepare for changes in the CMI operation or changes in routine operations affecting their work in the demonstration
- Their participation in routine decisions regarding CMI

These people will also be asked to identify other problems, and suggest solutions.

The ETs will be asked the same questions as the ESO, DTC/POs, the LS, and the CMI advisor. The questions, however, will address the ETs duties in maintenance as well as in substituting for the LS when the latter is off duty. The ETs will also be asked to assess the importance of their losing time from normal duties.

Students will be asked the same questions as the ETs, with emphasis on the changes to the student's watch duties. They will be asked to assess the importance of the reduction in normal duties, and to suggest changes related to scheduling or any other aspect of the CMI organization and management structure.

At the end of the demonstration an assessment will be made of the effectiveness of the organization and management structures used during the demonstration. Requirements for a structure to support an operational CMI system will be inferred.

H. Space Requirements and Operational Procedures

This objective is concerned with the extent to which day-to-day student and CMI staff procedures and the facilities enhance or hinder the students' progress. In the periodic interviews to be held by the PRC staff, the ESO, ETs, LS, CMI advisor, and students will be asked to assess the adequacy of:

- Learning center space and facilities, especially the use of the conference room tables for study, lab work, and exams
- The scheduling of study, lab work, and exams, including use of materials
- The scheduling of interaction with the LS and ETs
- The tasks and their scheduling for ETs
- The procedures for keeping student and key personnel logs, entering study time into the computer

Figure III-7 shows the layout of the conference room at the Stockton Complex with the location of storage cabinets for CMI material, the LS's desk, and the Opscan/ Terminet cluster.

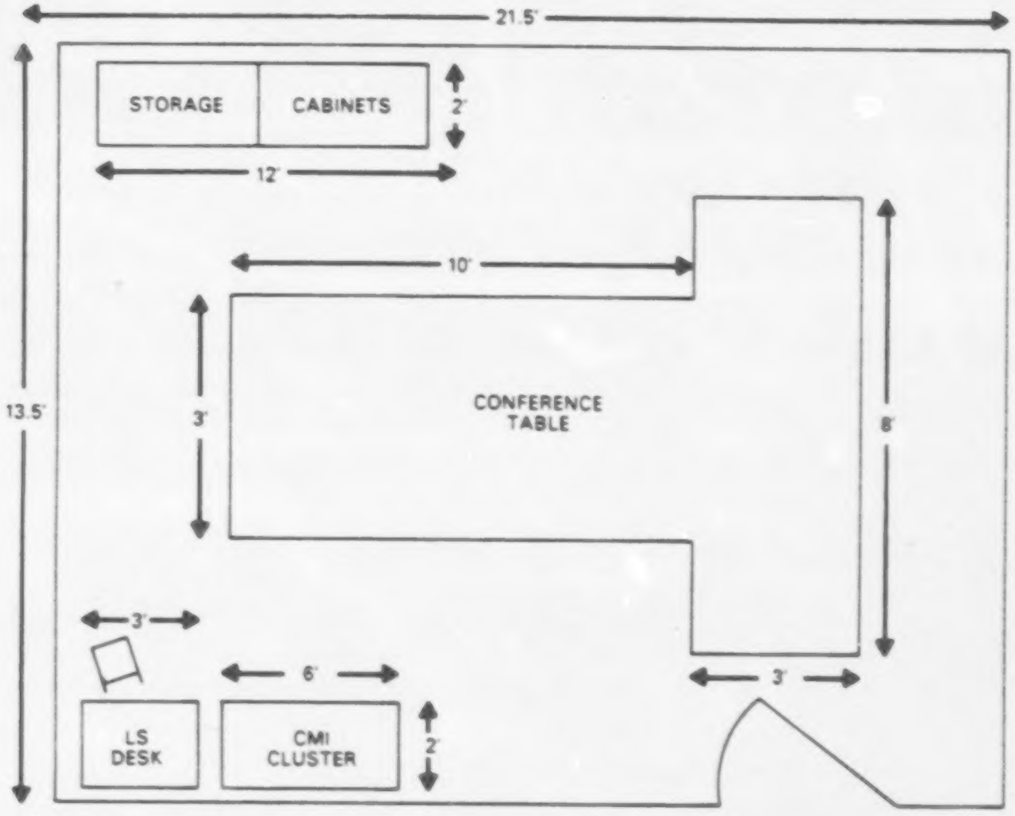

Figure III-7. Stockton CMI Demonstration Learning Center

The interview responses will be reviewed by PRC staff and an assessment made of which characteristics are important for successful operation of CMI onsite. Inferences will be drawn for large scale operation of CMI.

I. Equipment, Maintenance, Spare Parts, and Logistics Requirements

This objective is concerned with matters of smooth and effective operation, and the requirements in terms of the type and number of pieces of equipment, maintenance response time, availability of spare parts, and the ease of replacing stocks of spares and expendable supplies. The costs of these are considered in the economic analysis. Here the emphasis is on the acceptability of the operation to the personnel.

The maintenance activities are as follows:

- Communication line and Opscan/Terminet cluster under contract
- Lab equipment by ETs as part of their watch duties
- Microfiche readers by the local distributor at Stockton

Expendable supplies will be ordered by the ESO as needed, following the established routine at Stockton.

The observations and periodic interviews conducted by PRC staff address the issue of personnel satisfaction with the demonstration plan for equipment, maintenance, spare parts, and logistics. In addition, each week the PRC staff will collect the following data from the maintenance logs and key personnel time logs:

- Response time of maintenance technician
- Total down time
- Number of instances and the delay resulting from inadequate spares
- Unused spares

- Number of instances of inadequate supply of expendables, Opscan test sheets, and administrative forms (P1, P2, and P3); Terminet paper; time before new delivery

During the demonstration the PRC staff will document the procedures and specific activities for equipment, maintenance, spares, and logistics. The information and data will include maintenance response time, down time, use or lack of use of spares, spares shortages, and shortages of expendables. An assessment of the level of satisfaction or dissatisfaction with the demonstration procedures will be obtained from the PRC observations and interviews. From this, requirements for onsite delivery of CMI will be derived and an assessment made of how they might change as the scale of the CMI effort changes.

J. Conclusion

The research design described here will provide the data and analytical procedures to achieve the objectives of the demonstration. The scheduling of these research activities and the assignment of responsibilities to PRC and Navy personnel are described in the next chapter.

Chapter IV

DEMONSTRATION DESIGN

A. Introduction

The demonstration can be considered as a three part operation:

- The CMI course, with the activities of students and supporting personnel
- Research activities, consisting of data collection and analysis
- Support activities, which put into place the physical systems, equipment, and material needed to operate the demonstration

For some people participating in the project there is overlap between these areas. Generally, however, they represent a clear separation of functions. Within each area, separate treatment is given to the activities required in the preparation, conduct, and evaluation of the demonstration. This chapter addresses each of these areas, providing a component by component description of how the demonstration will be made to happen. Where necessary the details of day-to-day activities are described in terms of what will be done, who will do it, when, and how. A comprehensive description showing how the pieces fit together is given in Chapter VI, "Demonstration Master Plan."

B. Operations

This section describes specific activities which must be carried out during preparation, demonstration, and evaluation in order to offer the CMI BE/E and correspondence courses.

1. Preparation

The activities required during the preparation phase are:

- Select CMI and correspondence students
- Assign and train an LS for the demonstration
- Assign a CMI advisor
- Conduct an orientation session at Stockton for site staff who will support the demonstration
- Schedule the activities of key site personnel and students
- Provide a student orientation session and a walkthrough of the communication system operation for the students and key site personnel

a. Selection of CMI and Correspondence Students

The ESO is responsible for selecting and providing PRC with a list of students who have volunteered to participate in the BE/E Course File 69 CMI course at Stockton. Student volunteers must also be selected for the correspondence version of the BE/E course.

The ESO is responsible for making the program known and available to all RM personnel who might be interested. Once students have indicated that they wish to participate in the CMI or correspondence course, it will be the responsibility of the ESO to have each individual sign a standard Naval permission form which describes the nature of the research, and indicates to the volunteer the right to disenroll in the project should it become necessary.

It will also be the responsibility of the ESO to collect and tabulate the data required for each CMI student for registration: name, social security number, branch of service, classification, year of birth, number of years of schooling, Armed Forces Qualification Test

(AFQT) scores, and Basic Test Battery (BTB) scores. It will be necessary to have the same data tabulated for the correspondence students.

On July 11 the ESO will submit to PRC a preliminary list of CMI volunteers with the registration data, but with the names and social security numbers covered. These data are to be used in a trial run by MIISA Memphis of the BE/E CMI prediction program. An estimate of completion times for the Stockton students will be secured by July 15 and used to refine the projected schedules. By August 8, the student lists will be finalized and the ESO will prepare the needed registration information using the student registration card format shown in Appendix H. This information is to be mailed to MIISA San Diego with a copy provided to PRC staff. The latter will be at Stockton from August 8 through the second week in September. The final estimate of completion times will be made August 12, when the students are registered.

Beginning July 18 the ESO will survey outlying site personnel to determine who will take the correspondence course. The list will be finalized by August 8.

b. Assignment and Training of LS

It will be the responsibility of CNTECHTRA to assign and train an LS for the demonstration. The LS selection and training will be ordered by the Electronics TPC, with selection by July 11 and training to be initiated July 18. The LS should have an ET rating, and should be able to spend seven months in Stockton. If it becomes impossible to select an LS who can stay on location for the entire demonstration, it will be necessary for CNTECHTRA to select more than one LS in order to maintain a continuous full-time position at the Stockton site.

c. Selecting and Assigning a CMI Advisor

CNTECHTRA is responsible for selecting and assigning a CMI advisor by July 15 to arrive at Stockton no later than August 20. The advisor should be someone who has considerable experience in the CMI training program and is knowledgeable in the electronics field. This person will be required to oversee the entire operational set-up as well as provide ongoing apprisal of the operation during the first weeks of the demonstration.

d. Staff Orientation at Stockton

On August 22 PRC will hold an orientation meeting at a designated room in the administration building at Stockton with the LS, CMI advisor, ESO, DTC/POs, Division Officers, Communications Officer, and the Base Commander. The purpose of this orientation, expected to require one to two hours, is to brief all key demonstration personnel on the status of the demonstration design. Scheduling of key personnel and students and the activities to be carried out by key personnel will be discussed. The orientation session will be chaired by the principal investigator from PRC.

Beginning on Monday afternoon, August 22, and continuing throughout the week, meetings of about three hours will be held on watch time with the senior maintenance personnel. These are the ETs who will substitute for the LS while the latter is off duty. The ETs will also maintain the laboratory equipment during the demonstration. PRC staff will also be responsible for this session with assistance from the LS and the CMI advisor. Since the ETs will serve as resource persons, it will be important to determine how well acquainted they are with the course materials. At a minimum, two hours of this orientation should be devoted to a review of each module topic area with the LS serving as the leader of this phase. The remainder of the orientation will be devoted to acquainting the ETs with their equipment maintenance responsibilities.

e. Scheduling of Activities

Using the initial estimate of time-to-completion for the CMI course received August 15, the ESO and PRC staff will develop a tentative schedule for students and key personnel by August 19, including review meetings. On the morning of August 29 an operational scheduling session will be held in the morning in the conference room at the Stockton blockhouse. The LS, CMI advisor, PRC staff, Division Officers, Communications Officer, ESO, and DTC/POs from Stockton are required for this session. The tentative schedule prepared by the ESO and PRC staff will be received. The end product will be schedules for the LS and ETs over the entire demonstration, monthly project review meetings for key site personnel and testing and interviews by PRC staff.

CMI student schedules will be set in meetings with the ETs over the week of August 29 to September 2, beginning the afternoon of the 29th. The PRC staff, the LS, the CMI advisor, and the Division Officers will participate.

On the morning of August 30 an operational scheduling session will be held for the correspondence course in the conference room. The ESO, the Communications Officer, Officers-in-Charge, and DTC/POs of the outlying sites of the Stockton activity, and the PRC staff will attend this morning session to schedule the course work for students who will be taking the BE/E correspondence course at the component sites. The session will also produce an estimate of the involvement of the ESO and DTC/POs who will be handling student tests, monitoring students, and advising as needed. The course materials will be presented to the DTC/POs by the ESO for dissemination to the students.

f. Student Orientation, and Student and Key Personnel Walkthrough

Beginning the afternoon of August 30 and continuing through September 2, the students, ETs, DTC/POs, and the ESO will be introduced to the course and briefed on the operation of the Opscan/Terminet cluster and the use of materials from the learning center. The schedule of the walkthrough will have been determined in the workshop of August 29 and coordinated so as not to conflict with the operational schedule meeting. The LS and CMI advisor will be required to conduct these sessions with assistance from the PRC staff. A brief meeting of about 20 minutes will be held with the students to describe the course. Then, there will be a pilot run of the communication system, with selected student volunteers taking a sample test, feeding the test answer sheet into the Opscan, and receiving feedback on the Terminet printer. Time will be spent to answer student questions

2. The Demonstration

This section presents operational requirements and procedures to be followed during the conduct of the demonstration for the following:

- Daily and weekly routine for the CMI course
- CMI student
- Learning Supervisor
- ETs
- ESO
- DTC/POs
- Communications Officer
- Division Officers
- The CMI advisor
- Daily and weekly routine for the correspondence course

- Correspondence student
- DTC/POs

a. Stockton CMI Course

(1) Daily, Weekly, and Monthly Routine for the CMI Course

This section provides an overall view of demonstration procedures. The routine operation involves the students, the LS and the ETs. Throughout the demonstration the students will spend an average of 10 hours per watch string. Since Stockton is on a rotating watch bill as shown in Figure IV-1, course activity will be taking

MARCH

DATE:	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
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APRIL

DATE:	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
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MAY

DATE:	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
DAY:	S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T
MID:	4	4	1	1	2	2	3	3	4	4	1	1	2	2	3	3	4	4	1	1	2	2	3	3	4	4	1	1	2	2	3
DAY:	1	1	2	2	3	3	4	4	1	1	2	2	3	3	4	4	1	1	2	2	3	3	4	4	1	1	2	2	3	3	4
EVE:	3	4	4	1	1	2	2	3	3	4	4	1	1	2	2	3	3	4	4	1	1	2	2	3	3	4	4	1	1	2	2

JUNE

DATE:	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
DAY:	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T
MID:	3	4	4	1	1	2	2	3	3	4	4	1	1	2	2	3	3	4	4	1	1	2	2	3	3	4	4	1	1	2
DAY:	4	1	1	2	2	3	3	4	4	1	1	2	2	3	3	4	4	1	1	2	2	3	3	4	4	1	1	2	2	3
EVE:	3	3	4	4	1	1	2	2	3	3	4	4	1	1	2	2	3	3	4	4	1	1	2	2	3	3	4	4	1	1

Figure IV-1. Sample Watch Bill

place over a 24-hour day, seven days a week. This activity has to be modified, however, from what occurs at a schoolhouse:

- The CMI computer is not available around the clock. The CMI concentrator in San Diego is the controlling factor in allowing access to the CMI computer in Memphis. The concentrator is on-line from 0600 to 1830 Pacific time, Monday through Friday, so it is only between those hours and on those days that normal student-computer interaction procedures can be followed. During this time students arriving at the learning center will submit a P1 administrative form through the Opscan to log in. Any tests taken by the student during that time will be entered in the Opscan as soon as they are completed by the student. The computer in Memphis will score the tests and direct the student to the next assignment by a message printed on the Terminet. At the end of the study period the student is to submit a P2 administrative form to log out. CMI experience shows that students often forget to log out with a P2 form. Therefore, it is important that the students maintain time cards. The LS can refer to the cards and enter a P3 form to correct the student's file if a P2 was not used to log out. When there is no connection to the CMI computer in Memphis, the students can work up to the point of completing an exam.

- Only one LS will be available, and only Monday through Friday, 0800 to 1600.

- At any time of day there are ETs on duty. They will be on call to handle administrative and course content questions in the absence of the LS. In addition, the ETs are responsible for maintenance of lab equipment.

- No more than half the students at a time will be permitted to leave their duty station at a time during their watch to work on the course. This is a requirement to avoid impairing communication activities.

- Since the evening watch is very busy, students will not be able to work on the CMI course when they have that watch. To make up for the course time lost from the evening watch, students can spend three hours on the mid watches when the work load is low. During day watch students can be expected to spend two hours on the course, for a total of 10 hours of course work per watch string. Each watch string consists of six watches plus 80 hours off covering eight complete days.

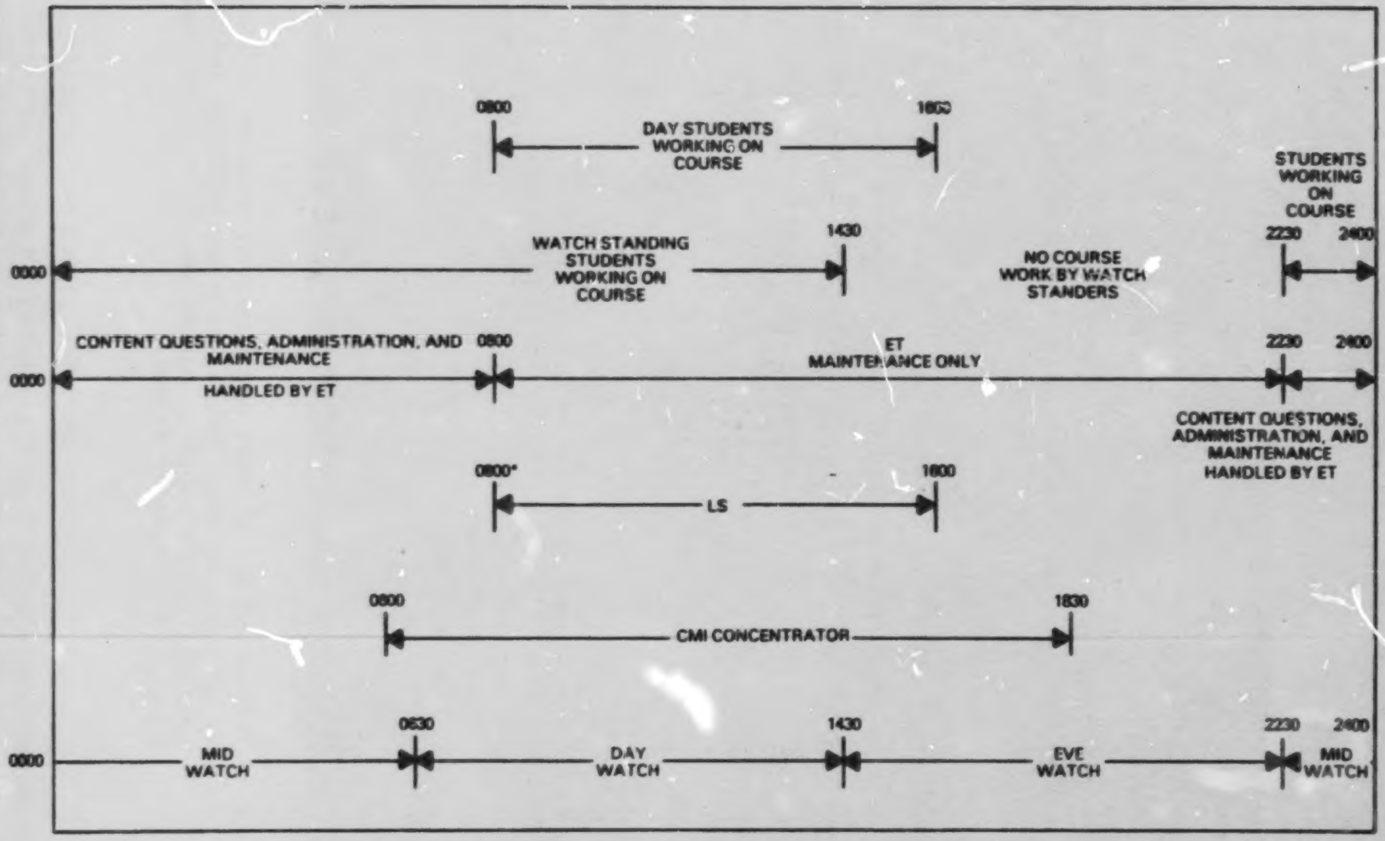
Figure IV-2 shows the effect of these operational factors on personnel responsibilities for a typical weekday. The ETs participate in the demonstration only in the absence of the LS, and are responsible for both administrative matters and technical questions. Their maintenance responsibility extends across the whole day. When needed to monitor lab work or performance tests, they will spend a major portion of their watch in the learning center.

When the LS arrives in the morning, he will enter three sheets through the Opscan for each student: The first is a P1 form stating an artificial student start time such that the period between that time and the time the LS enters the sheets into the Opscan equals the actual study time spent by the student. The second form is the test sheet, and the third is a P2 form for logging the student out.

On a weekly basis, routine activities will vary as follows:

- Saturday and Sunday--The LS will not be on duty, so the responsibilities of the ETs will be as shown in Figure IV-2 for the mid and day watches. The students will follow the appropriate time sheet entry and test procedures when the concentrator is down (1830-0600 Pacific time).
- Monday--The LS should receive the learning center roster from MIISA San Diego which summarizes student progress. Consultations would have to be arranged for students who are not doing well.
- Friday--LS and ET cost and time logs will be collected by the LS and sent to PRC. MIISA San Diego will run and mail the learning center roster. During the first month rosters will be mailed on Tuesday as well.

All study, test and laboratory materials, student time sheets, and completed test sheets will be kept in locked storage cabinets in the learning center. The LS will keep the cabinets unlocked while working in the learning center. At all other times the


0800
1600
DAY STUDENTS WORKING ON COURSE
STUDENTS WORKING ON COURSE
1430
2230
2400
0000
WATCH STANDING STUDENTS WORKING ON COURSE
NO COURSE WORK BY WATCH STANDERS
CONTENT QUESTIONS, ADMINISTRATION, AND MAINTENANCE HANDLED BY ET
0800
ET MAINTENANCE ONLY
2230
2400
0000
CONTENT QUESTIONS, ADMINISTRATION, AND MAINTENANCE HANDLED BY ET
0800*
1600
LS
0800
1830
CMI CONCENTRATOR
0000
MID WATCH
0630
DAY WATCH
1430
EVE WATCH
2230
2400
MID WATCH

*LS WILL SUBMIT TIME AND TEST PAPERS FROM EARLIER SHIFTS.

Figure IV-2. Daily Routine

cabinets will be locked with keys available in the master key box in Tech Control. A log book will be kept at the box for students or ETs to sign out when using a key.

Each month, a review meeting, chaired by the LS, will assess the effectiveness of demonstration procedures and schedules, and revise them as appropriate. The participants will be the LS, ESO, DTC/POs, ETs, Division Officers, and Communications Officer. Two of these meetings will be held in the first two weeks to assure a good start for the demonstration. These first two meetings will differ from the general format in that the CMI advisor will participate, and the PRC staff will develop the agenda and an assessment of proposed changes in procedure or schedule. The monthly meeting agenda will be prepared by the LS.

(2) The CMI Student

The general study procedure for the CMI student begins by reporting to the learning center at the scheduled time during the watch. After checking in with the LS or designated ET, the student begins study with the assigned materials.

When the student arrives at a point of being ready for a module test, the microfiche test cards will be provided by the LS or ET. After successfully completing a module test, the student will receive instructions on the Terminet to proceed to the next module. The LS or ET will provide assignment materials for the next module and will keep a record of student progress in each student's file using the form from Appendix L. The student will keep a study procedures file (shown in Appendix L) as a backup, and will be expected to maintain reasonable progress on course materials based on CMI computer projections. Should any student fall 30 percent behind, he or she will be counseled by the LS.

Assuming these procedures, a time estimate for student progress through the CMI course is presented in Figure IV-3. The scenario is based on estimates derived from the Course File 69 BE/E schoolhouse data for the slowest student. The reader should remember that no data currently exists for estimating projected completion times for the BE/E course in an operational training environment. This figure is based on the schoolhouse data for students requiring an average of 200 hours to complete the course. The figure also assumes some "start up" time for each module or lab performance activity and accounts for some vacation time during official holiday periods. Specifically, the following assumptions were made in preparing the chart:

- The dates are estimated for the last group to start the course, the group whose watch string does not begin until September 9.
- Three days are taken off at Thanksgiving.
- Nine days are taken off at Christmas.
- After returning from leave, students rejoin their watch section the next time it is on duty.

Based on these assumptions, the last student is expected to finish by February 24.

(3) The Learning Supervisor

The LS is required to perform the following activities on weekdays between 0800 and 1600 hours:

- Advise students on the use of the Opscan and Terminet, the use of test papers, maintenance of the time log and scheduling of their time, and administer examinations.
- When requested, assist students on substantive questions relating to course content, their progress, and remedial work where needed. This procedure is particularly crucial during those times indicated in Figure IV-3 as difficult.

	Estimated Time (Hours)	Day/Date Completed
MATH 1		
MOD 1	12.3	S - 09/17/77
MOD 2	9.0	S - 09/25/77
exp. 3-4		
PT 3	12.0	M - 10/03/77
MOD 3	9.2	Tu - 10/11/77
exp. 4-1		
exp. 4-3		
PT 4	6.9	Tu - 10/18/77
MOD 4	9.7	W - 10/26/77
MATH 5		
exp. 5-2		
**MOD 5-1		
exp. 5-5		
PT 5	5.1	S - 10/29/77
**MOD 5-2	8.1	F - 11/04/77
MATH 6		
exp. 6-2		
exp. 6-3		
PT 6	15.5	W - 11/16/77
*MOD 6	15.3	Tu - 11/29/77
exp. 7-1		
PT 7	7.4	S - 12/04/77

	Estimated Time (Hours)	Day/Date Completed
*MOD 7-1		
*MOD 7-2	13.4	W - 12/14/77
DC COMP		
MOD 8	7.2	S - 12/18/77
MATH 9		
exp. 9-6		
MOD 9	14.3	M - 01/09/78
MATH 10		
exp. 10		
MOD 10	10.2	Tu - 01/17/78
MOD 11-1		
exp. 11		
MOD 11-2	7.9	M - 01/23/78
MATH 12		
**MOD 12-1		
**MOD 12-2		
**MOD 12-3	7.6	S - 01/29/78
exp. 13		
PT 13	8.8	M - 02/06/78
*MOD 13	13.9	F - 02/17/78
*MOD 14-1		
exp. 14		
*MOD 14-2	6.2	F - 02/24/78
AC COMP		

*Require more LS supervision

**Require more LS supervision, typical failure points

Figure IV-3. Time Estimate For Completion Of CMI Course

- Maintain student performance files and schedule students to use the learning center and lab equipment, administer tests. A file cabinet for performance files and other administrative material will be stationed in the learning center. The LS should check student progress and other administrative matters at the beginning of each day.

- Check computer time entries (log-in and log-out) by day students and check later time data for evening and mid watch students. As indicated earlier, this is particularly important since students may forget to log out with the P2 form at the conclusion of a study period.

- Maintain the stock of materials, including Opscan test sheets, administrative Opscan sheets (P1, P2, P3), expendable supplies, Terminet paper, module tests and exams. There will be space available in one of the storage cabinets for these materials. The LS will inventory these materials each Friday.

- Request and check on maintenance of the Opscan, Terminet, and lab equipment as needed

- Coordinate student and ET activities with the ESO, DTC/POs, Communications Officer, and Division Officers. A meeting will be held once a month to appraise the status of the CMI training activities and revise procedures as needed. One meeting will also be held each of the first two weeks of the demonstration.

(4) Senior Maintenance ETs

The major functions of the ETs will be to:

- Substitute for the LS on mid and day watches when the LS is off duty

- Maintain lab equipment on an "on-call" basis

The administrative functions include answering student questions on log entries, providing access to course materials, administering exams, checking student log-in and log-out on the Opscan when the computer is on line, and collecting exam papers and student study times for entry by the LS when the computer is on-line. The content-related functions include answering student questions on the content of the course, and supervising lab work and performance tests.

All exam papers and student study times that are collected during computer down times will be placed in a file marked for that purpose in the learning center storage cabinets. This is to be locked by the ETs along with all other storage cabinets during their watches and the keys kept in the designated box in Tech Control.

The ETs will maintain time records of their activities and will participate in the monthly review meetings.

(5) The Education Services Officer

The ESO will perform the following activities in support of the CMI course:

- Establish student files containing student registration data for use by LS. The LS will add time cards and other progress information as appropriate
- Coordinate routine training activities with the CMI course
- Participate in the monthly review meetings
- Assist the LS in coordinating with and monitoring students
- Maintain time records of his activities

(6) DTC/POs

The DTC/POs' responsibilities include:

- Coordinate Division training with the CMI course
- Participate in the monthly review meetings
- Assist the LS in working with Division students
- Maintain time records of their own activities

(7) Communications Officer

During the demonstration the Communications Officer will do the following:

- Coordinate the use of the learning center with the LS. The room is to be preempted whenever needed for Fleet Center use. At the August 29 workshop a schedule of routine Fleet Center meetings will be adopted so CMI activities can be planned around them. The Communications Officer will provide as much advance notification to the LS as possible for unexpected meetings.
- Coordinate with the LS, and approve the scheduling of students and ETs for the respective tasks. This will be done initially in the August 29 workshop and revised as needed in the monthly review meetings with the LS and other key personnel.
- Serve as a liason between CMI training personnel, the Fleet Center staff and the base commander
- Maintain time records of his activities

(8) Division Officers

The Division Officer will be responsible for coordinating Division activities with the CMI operation. This will be initially done at weekly meetings, and later at the monthly meetings. Any unusual involvement will be logged and reported to the LS.

(9) The CMI Advisor

During the first few weeks of the demonstration the CMI Advisor will assist the LS and other project personnel as needed. The advisor will follow a part-time schedule of observing activities seven days a week and will assist the LS in refining operational procedures and solving problems as they arise. At the conclusion of his stay at the demonstration site, about September 19, the advisor will spend a day debriefing PRC staff.

b. Stockton--Correspondence Course Sites

Individuals at the Stockton outlying sites will take a correspondence version of the BE/E course. The sites are: Mare Island, Skaags Island, Treasure Island, Monterey, Dixon, Oakland, Moffett Field, and Alameda.

Since the correspondence course is self-taught and self graded, the follwing personnel will participate in the demonstration:

- The correspondent students
- DTC/POs
- The ESO

(1) The Correspondence Student

The correspondence students will spend an average of 10 hours per watch string studying course material, thus completing each lesson in two weeks or less. At the end of each lesson, the student will take a self-graded test and mail the test, along with a time record, to the ESO. Upon satisfying lesson requirements, the student will move on to the next lesson, thus completing the course in about 18 weeks. The last student is expected to finish by January 20, 1978.

(2) DTC/POs

Upon requests by the students or the ESO, the DTC/POs will work with students having difficulty.

(3) The ESO

The ESO maintains correspondence student files of completed tests and time records sent to the ESO by students at the off-base sites. These files will also contain the same personal and aptitude data which is used for registration of the CMI students. The complete file will be used in evaluating the students' performance and attitudes, will be available by January 27.

3. Evaluation

Operational requirements during the evaluation phase of the COMISAT project involve the LS and ESO.

a. The Learning Supervisor

The primary responsibility of the LS during the evaluation phase will be to participate in the formal closing of the CMI course. The LS will receive the Graduate Performance Summary and Attrition Performance Summary data from MIISA San Diego and review them to determine that everything is in order. The LS will also chair a demonstration debriefing session with PRC staff and key support personnel. This meeting is to be announced immediately following the graduation of the last demonstration students.

b. The ESO

The ESO will participate in debriefing sessions to be held following the completion of the CMI course. The ESO will assist in administering the common performance exam to both the correspondence and CMI students.

C. Research Activities

The activities to be carried out in meeting the eight research objectives of the demonstration are described here for each objective. There are separate discussions of preparation, demonstration, and evaluation activities for each objective.

1. Learning Effectiveness

a. Preparation

During the preparation phase, experimental and control groups will be assembled to evaluate the effects of CMI onsite training versus CMI training center training on learning effectiveness. Background information will be gathered for evaluation efforts and estimates of completion times will be computed to aid in scheduling the delivery of the CMI course.

In the first activity of the preparation phase, MIISA Memphis will identify a pool of control group subjects using Course File 69 historical records of course performance data. The entire file is to be searched for records of personnel from the E4 to E6 paygrade who have taken the BE/E 69 course. By July 22, 1977, a hardcopy of the results will be provided to PRC for review. By July 29, 1977, a control group of 30 or more subjects will be selected. PRC will then tabulate all of these data on the tally sheet shown in Appendix H for analysis during the evaluation phase.

A group of experimental (CMI) and correspondence students will be identified at the NAVCOMMSTA Stockton. The ESO at Stockton will mail this information on August 8, 1977 to MIISA San Diego for registration of CMI students with copies to PRC on site at Stockton. The following demographic data for CMI students will be supplied by the ESO:

- Social Security Number
- Name
- Rate
- Branch of Service (Navy, Marines)
- Year of Birth
- Years of Education
- Armed Forces Qualifications Test Score
- BTB scores

MIISA San Diego will code the data on the student registration card for the registration process (see Appendix H). After the official registration is completed by MIISA San Diego, by August 12, a copy of the learning center roster is to be mailed from MIISA San Diego to the ESO at Stockton and to PRC at McLean, Virginia.

MIISA Memphis will establish a learning center complex I.D. number by August 8, 1977 and notify MIISA San Diego by telephone. This information is needed for personnel at MIISA San Diego to accomplish the registration of CMI students in the system. That will be done by August 12, 1977.

The ESO at Stockton will identify a group of correspondence students at various NAVCOMMSTA Stockton outlying sites by August 8, 1977. The ESO will enroll the students in the BE/E correspondence course through NAVEDTRA Pensacola. The same background data on level of education and ability used for CMI student registration will be collected by the ESO for the correspondence students and used by PRC to evaluate correspondence student performance.

b. The Demonstration

During the demonstration, a complete record of all student time spent in study and testing for the CMI program must be kept. For the CMI students, data records are kept by computer as described in the Operations section, with a backup record on a timecard as shown in Appendix J. This card will contain a chronology of the student's study program for authorized time during his watch, any extra study time he spends, and lab and test time.

Correspondence students will record study time and related activities during the demonstration in the same manner as CMI students except the data will not be recorded in the computer system. While this course performance will not be compared to CMI course data, it will be used when the special examination scores are compared. The ESO will maintain a summary progress report on those students using the form in Appendix J.

During the first three weeks of October 1977, the Stanford Diagnostic Reading Test (Form B, the Blue Level) will be administered by a PRC representative with the assistance of training personnel at the outlying Stockton sites and at the main base. The scoring and coding of these data for computer analysis will be the responsibility of PRC staff. The measure of interest in this test will be the student reading ability score expressed in grade unit levels.

The testing takes approximately two hours and will be given to students on their normal watch. The first testing at Stockton will take place on Monday, October 3, 1977, with the rest of the week used to test those who were not scheduled for duty on Monday, or who missed the first session for some other reason. For those who are day workers, testing will follow the same procedure except they will report at some time during their shifts.

Because of distances between outlying sites and the desire to test students on-watch, PRC staff will not administer the test directly at those sites. Instead, the PRC staff will meet with the DTC/POs and arrange for them to test their students. The PRC staff will visit two sites per day as follows:

- Monday October 10
  0800--Mare Island
  1300--Skaags Island
- Tuesday, October 11
  0800--Moffett Field
  1300--Monterey
- Wednesday, October 12
  0800--Oakland
  1300--Alameda
- Thursday, October 13
  0800--Dixon

The DTC/POs will conduct the tests during the week following the PRC visit. All testing will be completed by Wednesday, October 19.

PRC will develop the special examination for comparing student achievement through the correspondence course with that for CMI by December 15. The test will be given on-watch by the DTC/POs at Stockton and the outlying sites. Each student will be scheduled to take the exam within two to seven days after completing their course. This will allow some grouping to save ESO and DTC/POs time. The last exam will be taken by March 3 and the results sent to PRC so as to arrive by March 10.

At the conclusion of the demonstration, when all students in the experimental group at Stockton have completed BE/E course requirements, an administrative report summarizing each student's recorded time data is to be sent by MIISA Memphis personnel to the ESO and the LS, and to PRC. The total amount of time required for each student to complete the course and BTB scores will be coded from the report to the data tally sheet by PRC for statistical analysis.

c. Evaluation

Actual course completion time data will be automatically stored in the CMI computer. The ESO will assist PRC staff in tabulating this data on the appropriate ESO tally sheet. Copies of the data tally sheet are to be filed with the ESO at NAVCOMMSTA Stockton and at PRC in McLean, Virginia.

PRC staff will code course performance data from the data tally sheets onto computer cards for the analysis, and complete the covariance analysis described in Chapter V by March 24.

By March 24, PRC staff will also have completed the analysis of the special achievement examination.

2. Attitudes

a. Preparation

The preparation phase begins with the CNTECHTRA Memphis BE/E TPC identifying a group of 55 students from the training center at Great Lakes and 55 students from the training center at Memphis to participate in a pilot validation of the attitude instrument. The arrangements for this survey must be made so the validation can be conducted the week of July 18, 1977 at Great Lakes and during the week of July 25 at the training center in Memphis. PRC will administer the validation as well as score and code the data for factor analysis.

The procedures for collecting this data will be the same at the two locations. The selected students will report for the survey within one day of completing the CMI course to select the session they wish to attend. The survey will be administered twice a day, once in the morning and once in the afternoon, for a weekly total of 10 sessions.

Each session will last about an hour. During the first 20 minutes students will listen to tape recorded instructions and PRC staff will answer questions. The survey itself will take about 40 minutes. At the end of the hour, one student from each session will be selected to stay for a two-hour detailed oral interview. There will be 10 interviews from each of the two locations.

Scoring and coding of the semantic differential data is the responsibility of PRC, with the factor analysis scheduled for the week of August 1, 1977. The validation will be completed by August 12.

The hour-long attitude survey pretest will be administered by a PRC representative beginning August 22, 1977. Scoring and coding of this data will be PRC's responsibility. No immediate statistical analysis is required for this pretest data. The data will be recorded on the data tally sheets for later evaluation.

The procedure for accomplishing this data collection begins Monday, August 22, 1977. During that week CMI students at NAVCOMMSTA Stockton will report to the training division classroom in the administration building at a specified time during their regularly scheduled watch. Day workers will report to the testing site at a specified time during their shift.

Although the attitude control group has not yet been determined, the procedure will be essentially the same, with the pretest administered during the student's CMI orientation. This testing will be supervised by PRC staff, and will be completed sometime in November.

b. The Demonstration

During the demonstration phase, attitude posttest data will be collected from CMI students as they complete training. Posttest attitude surveys at NAVCOMMSTA Stockton will be administered by PRC staff. This procedure requires about one hour to complete, and will be similar to the pretest.

Upon graduation, CMI students will report to the training division classroom in the administration building where PRC staff will be present to administer the survey and interviews. The same staff will score and code the attitude posttests as they are completed. The posttests will be completed by February 28.

Posttest attitude surveys for the control group will be administered at the conclusion of the course in the same room as the pretest. The procedure will be the same as for the experimental group, and are expected to be completed by December 31, 1977.

c. Evaluation

During the evaluation phase all attitude data will be prepared by PRC for analysis by the Biomed Computer program. Since there are seven different attitude concepts being measured in the demonstration, each will require a separate analysis. The analysis is scheduled to proceed immediately following the conclusion of the interviews and will be completed by April 14, 1978.

3. Economic Evaluation

a. Preparation for the Demonstration

In the preparation phase, there are two activities:

- PRC will produce four forms by August 20:
  - -- Maintenance log
  - -- Student timecard
  - -- Correspondence course student progress form
  - -- Key personnel time log

  (Samples of these four forms are given in Appendix J.)
- PRC will distribute and explain the use of the CMI forms to key Stockton personnel at a workshop planned for August 29.
- The LS and ETs will be given the maintenance log and see to it that contractor maintenance personnel fill out the appropriate log on call, and that the ETs keep them up to date when they perform maintenance.
- PRC will provide the ESO with the correspondence course student progress form on August 30.
- PRC will distribute and explain the use of the key personnel time log to the MIISA San Diego Computer Center Director and the Deputy Director of MIISA at Memphis.

b. Demonstration Activities

The data required for the systems evaluation will be recorded by key personnel during the demonstration. As described in Chapter III, data collection mechanisms currently at the site will be utilized and an effort made to keep the data collection requirements to a minimum. The data collection activities are as follows:

- On the first working day of each month the LS will send a copy of the maintenance log to PRC in McLean, Virginia.
- At the end of the demonstration, MIISA Memphis will provide PRC with a complete cost breakdown of the communication system. The data will be provided by March 10.
- Student course time will be provided to PRC by MIISA Memphis for the CMI students by March 10. Total course time for the correspondence students will be sent to PRC by the ESO by the same date.
- The weekly submission of logs by key personnel will provide the time data needed for the economic analysis.
- The BE/E TPC at CNTECHTRA will provide PRC at McLean with an itemized costing of each shipment of lab equipment, microfiche readers, microfiche tests, texts, answer sheets, administrative forms, and Terminet paper. The cost data for the August 20 delivery will be sent to PRC at McLean by August 29. Later shipments, if needed, will be reported to PRC within a week of the delivery. In addition, the LS or ET will note in their logs any instances where equipment or materials are not available to a student.
- Correspondence materials costs will be obtained by PRC staff from the Naval Education and Training Program Development Center, Pensacola, Florida. A trip will be made the week of October 17-21 for one or two days of data collection.

c. Evaluation

The results of the demonstration will be used along with other data on training costs to determine whether revision to the cost-effectiveness analysis of CMI is necessary. A major extension of the analysis will be to assess the potential for CMI use in the Defense Department as a whole.

By March 10, 1978, the economic analysis data will be available to PRC from the demonstration. From that point until June 1, the demonstration results will be assessed and conclusions reached concerning the potential role of CMI in Navy training, and in overall

Defense Department training. Recommendations will be made concerning future Navy and Defense Department use of CMI.

4. Personnel Requirements

This objective is concerned with determining the tasks that have to be performed by onsite personnel and the level of effort required in order to support an effective CMI program. The personnel of interest are the LS, ETs, DTC/POs, ESO, Division Officers, and the Communications Officer.

a. Preparation

During the preparation for the demonstration the schedules and tasks of the key site personnel will be set. The workshop of August 29 will finalize plans. This objective is concerned with assessing the effectiveness of those plans.

b. Demonstration

PRC staff will observe the operation continuously over the first two weeks, and then interview the students and key personnel to see what might be done to improve tasks or schedules. The interview will be repeated two weeks later, then once a month until the end of the demonstration. The interview question related to this objective can be found in the total interview package contained in Appendix K.

Key personnel time logs will be reviewed by the PRC staff each week as they are received from the ESO. That information plus the interview responses will determine if any changes in task assignment or level of effort are warranted. If there are, the appropriate recommendations would be made by the PRC staff after consultation with key site personnel.

When approval of a change is necessary, the PRC staff will submit the recommendations in writing to the Communications Officer.

c. Evaluation

At the end of the demonstration in February 1978, the time log data and interview responses will be studied by PRC staff to assess the support personnel required per student. The extrapolation will infer the personnel requirements for an operational CMI onsite system. Conclusions will be developed by April 7.

5. Personnel Training Requirements

This objective is concerned with determining the training needed for site staff supporting CMI courses.

a. Preparation

During the demonstration, the LS will receive IT-BE/E training, and together with the CMI advisor, will train the ETs to carry out their responsibilities. Time spent by the LS and CMI advisor with the ETs will count towards training. To gather this data, in the preparation stage the LS and CMI advisor will maintain logs from their time of arrival at Stockton. Under "Administrative Activities" they will record the time spent and the particular activity in training the others, including all staff orientation sessions and walkthroughs. These LS and CMI advisor logs will be accumulated up to the start of the demonstration.

b. Demonstration

During the demonstration, the LS and CMI advisor will maintain their time logs.

The observation of procedures by the PRC staff and the periodic interviews to assess the effectiveness of operations (Appendix K) will address the adequacy of the training. The schedule of observation and interviews described for identifying personnel requirements will be followed here.

c. Evaluation

Beginning March 13, after the end of the demonstration and in parallel with the assessment of personnel requirements, the data and information on training will be studied and the actual amount of training time for key personnel summarized. The interviews will identify problems of inadequate training as well as areas of satisfaction. An assessment will be made of the adequacy of an advisory activity during the demonstration versus more complete preparatory training. Recommendations will be made on the amount of training for each key site person, the subjects to be covered, and the schedule of that training. This evaluation will be completed by April 7.

6. Organization and Management

This objective is concerned with determining the organization and management structure needed for successful operation of onsite CMI courses.

a. Preparation

The workshop of August 29 will finalize the organization of the demonstration. The interview package of Appendix K has been developed to address the capabilities and deficiencies of the organization and management structure, and how the CMI operation can interfere with routine duties.

b. Demonstration

Organization and management functions will be observed by PRC staff continuously over the first two weeks and for several days each month thereafter. The first major interview using the questions from Appendix K will be given at the end of the second week. Additional interviews will be given at the end of the first month of the demonstration and once a month after that. The interviews will precede each progress review meeting.

c. Evaluation

The results from interviews and PRC staff observations will be studied beginning April 10. From the interview responses, the organization and management structures used during the demonstration will be described and subjectively evaluated for effectiveness. The evaluation will be completed by April 28.

7. Space Requirements and Operational Procedures

This objective is concerned with the extent to which the facilities and day-to-day student and CMI staff procedures enhance or hinder the student's progress.

a. Preparation

The facilities will be in place by August 20, with two storage cabinets and an LS desk provided in the Building 120 conference room. By August 29, the learning center will have all the lab equipment, microfiche readers, and course print materials, and the Opscan/Terminet cluster connecting to the CMI computer in Memphis will be in place.

b. Demonstration

In the periodic interviews to be held by the PRC staff, the ESO, ETs, LS, CMI advisor, and students will be asked to assess the adequacy of the procedure and facilities.

c. Evaluation

A description of the facility setup and operational procedures followed throughout the demonstration will be prepared by PRC. The interview responses will be reviewed by PRC staff and an assessment made of which characteristics are important for successful operation of CMI onsite. Inferences will be drawn for large scale operation of CMI. This evaluation work will be initiated May 1 and completed by May 19.

8. Equipment, Maintenance, Spare Parts, and Logistics Requirements

This objective is concerned with smooth and effective operation, and includes requirements for pieces of equipment, maintenance response time, availability of spare parts, and replenishment of stock and supplies. The costs of these requirements are considered in the economic analysis. The following paragraphs emphasize the acceptability of the operation to the personnel.

a. Preparation

The equipment and spares required for the demonstration will be in place by August 29. Maintenance for the communication line and the Opscan/Terminet cluster will be provided under contract while ETs at Stockton will maintain the lab equipment as part of their watch duties. The microfiche readers will be maintained by the local distributor at Stockton. Finally, the ESO will order expendables as needed, following the established routine at Stockton.

b. Demonstration

The observations and periodic interviews conducted by PRC staff address the issue of personnel satisfaction with the demonstration plan for equipment, maintenance, spare parts, and logistics. In addition, data will be collected from the maintenance logs and key personnel time logs each week by the PRC staff.

c. Evaluation

The PRC staff will document the arrangements for equipment, maintenance, spares, and logistics. Performance measures will be summarized in terms of the maintenance response time, down time, use or lack of use of spares, spares shortages, and shortages of expendables.

Interview and observation results will be used to identify the level of satisfaction or dissatisfaction with the demonstration procedures. Requirements for onsite delivery of CMI will be stated, and an assessment made of how they might change as the scale of the CMI effort changes. The evaluation will begin May 22 and be completed by June 9.

D. Support Functions

This section describes the communications system, lab equipment, facilities, and print and other support materials required to carry out the demonstration.

1. Communications System

a. System Configuration

Servicing the demonstration communications needs requires an unconditioned voice grade telephone line connecting the Opscan/Terminet cluster and the San Diego CMI concentrator. Three land line alternatives were considered (as described in Appendix M) and a dedicated commercial line was selected for the demonstration. This alternative is expected to cost on the order of $500 and $550 more, respectively, than the other two dial line alternatives considered. The latter, however, would require "extensive" software modifications according to Honeywell and Pacific Telephone. No firm cost estimates were available, but the work would easily cost $1,500, eliminating the advantages of Alternatives 2 and 3 over the dedicated commercial line. In addition, the time and effort required to revise Honeywell's contract for the CMI concentrator would be eliminated.

Details of the comparison of these three alternatives, including the cost considerations, are contained in Appendix M.

b. Opscan/Terminet Cluster

The CMI system requires an Opscan 17 optical reader and GE Terminet 1200 teletype terminal. As described earlier, student test sheets are fed into the Opscan and the information is transmitted to the CMI computer in Memphis via the concentrator at San Diego. After the test is graded, instructions to the student are printed out on the Terminet.

A cluster consisting of one Opscan and one Terminet will be placed in the learning center. A second cluster will be kept in the ET storeroom in the blockhouse as a spare. The Opscan and Terminet will each be on a table with castors so they can be rolled into place quickly when needed.

Maintenance of the Opscan and Terminet equipment will be provided by the respective contractors. National Computer Services (NCS) will maintain the Opscan, and Honeywell will have the responsibility for the Terminet. In each case, service will be on call. The availability of a single spare for each component of the cluster is considered more than adequate based on MIISA experience.

c. Preparation

By July 1, 1977, CNET will have tasked the CMI System Manager to task MIISA Memphis to do the following:

- Lease, via COMNAVTELCOM, a two pair, type 3002, full duplex, unconditioned line from Stockton to San Diego. Bell 202-T modems should be used at each end of the line. The line will be activated August 29, 1977, at the latest.
- Have Honeywell install the RP6352 asynchronous line modulator at San Diego by August 29, 1977.

- Provide Stockton with two installed and operating OPSCAN/Terminet clusters by August 29, 1977. Delivery will take place by August 20, 1977.

By July 15, MIISA Memphis will complete contract negotiations with Honeywell for the following:

- Delivery of two Opscan/Terminet clusters to Stockton by August 20
- Installation and checkout of one cluster at Stockton by August 29
- Maintenance of the cluster on-call by Honeywell for the Terminet, NCS for the Opscan
- Installation of the RP6352 asynchronous line modulator on the CMI concentrator at San Diego by August 29

By the same date, MIISA must initiate negotiations through COMNAVTELCOM for a contract with Pacific Telephone to provide a dedicated phone line between Stockton and San Diego.

On August 1 the Opscan/Terminet clusters by Honeywell and NCS will be shipped. August 20 is the latest date for delivery of the clusters.

On August 29th Pacific Telephone will have an operating dedicated line, including modems, between Stockton and San Diego. Honeywell will have completed installation of the asynchronous line modulator to tie in the CMI concentrator in San Diego. Honeywell and NCS will also have completed installation and checkout of the cluster so there will be a fully operational CMI network on that date.

d. Demonstration

Maintenance will be provided by Pacific Telephone for the dedicated line and modems, by Honeywell for the RP6352 asynchronous line modulator and Terminet on call, and by NCS for the Opscan. The system will be used routinely beginning September 6 and will be closed down by February 28, 1978.

The maintenance log will be kept up to date during the demonstration for the Opscan, Terminet, and the dedicated line with modems and the line modulator.

The Opscan/Terminet cluster will be disconnected by Honeywell and NCS on February 28 and the units shipped to a site designated by MIISA. On the 28th the dedicated phone line will be disconnected by Pacific Telephone.

e. Evaluation

In the economic analysis, cost, down time, and maintenance data obtained from the demonstration will be used to assess the cost effectiveness of delivering CMI to remote sites. That study will be finished June 1. The effectiveness of the maintenance program and the reliability of the system are of interest in the analysis of equipment, maintenance, spares, and logistics requirements to be completed June 9.

2. Laboratory Equipment and Microfiche Readers

Table IV-1 lists the laboratory equipment and microfiche readers needed for Course 69. The cost of the equipment totals about $6,200.

The equipment needed for the demonstration is standard for Course 69 except that testing versions of the NEAT boards have to be modified. A lock box will be added over the test control knobs because the boards will be used for practice as well as testing to reduce the amount of equipment needed. Since it would be possible for students to

Table IV-1. Equipment List for BE/E Course 69

Items	Unit Price	Total
1. Four Simpson 260-5P Multimeter	$138.00	$ 552.00
2. Three RCA Oscilloscope Type WO-33A	$275.00	$ 825.00
3. Three EICO Model 337 Signal Generator	$120.00	$ 360.00
4. Three RCA WV-77E VTMV	$ 69.00	$ 207.00
5. Three WG-349A Direct/Low-Capacitance Probe and Cable	$ 15.00	$ 45.00
6. Training Devices		
Two N.E.A.T. Training Device #1	$300.00	$ 600.00
Two N.E.A.T. Training Device #1a	$300.00	$ 600.00
Two N.E.A.T. Training Device #2a	$400.00	$ 800.00
Two N.E.A.T. Training Device #6	$300.00	$ 600.00
Two N.E.A.T. Training Device #7	$300.00	$ 600.00
Two N.E.A.T. Training Device #9	$300.00	$ 600.00
7. Twelve Dry Cells, 1.5v	$ 3.00	$ 36.00
8. Four Hook-Up Wires (Off the shelf)	$ 2.00	$ 8.00
9. Four Sets of Meter Leads (Off the shelf)	$ 4.00	$ 16.00
10. Two Microfiche Readers	$175.00	$ 350.00
TOTAL		$6,199.00

decipher the variable settings of the test knobs during practice, security has to be provided in the form of a lock box. The LS and ETs will keep the keys.

a. Preparation

By July 1, CNET will have tasked CNTECHTRA to provide:

- Two full sets of NEAT testing boards on a no-cost loan, modified with a lock box covering the test control knobs
- The type and number of items of Course 69 lab equipment needed for 50 students

This will be shipped by August 1 and delivered to Stockton by August 20.

The LS and an ET will check out the lab equipment and microfiche readers on August 25. Repairs or replacements will be arranged as needed.

b. Demonstration

The lab equipment will be used by students under the supervision of the LS, or an ET when the LS is off duty. The microfiche readers will be used for CMI tests.

Maintenance of this equipment will be provided by ETs. There are no data available on maintenance requirements, but the staff using the equipment at CNTECHTRA Memphis see no need for major effort. An estimate of 16 hours per month has been made by PRC to cover maintenance.

A maintenance log will be kept. The microfiche readers will be serviced by a local distributor.

The LS and ETs will keep a record of equipment use to identify whether or not the provided equipment is adequate and necessary.

c. Evaluation

The cost and frequency of repair data will be used in the economic analysis. Equipment and maintenance needs for onsite CMI will be assessed based on the use data and results from interviews and observation. The study will be completed June 1.

3. Facilities

The learning center will be located in the blockhouse (Building 120) conference room. Two large conference tables, arranged in a "T" shape, will remain. Space is available at one end of the room for the Opscan/Terminet cluster, two standard six foot high metal storage cabinets, and a small desk for the LS. The cabinets, which will contain lab equipment, study materials, and microfiche readers will be locked when not in use. Figure III-7, in Chapter III on evaluating facilities, shows the dimensions of the room and possible placement of the equipment.

A maximum of five trainees is expected at any one time for scheduled study, testing, or laboratory work. Others may come in on their free time to move ahead in the work or do remedial work. The trainees will work at the conference tables.

Staff meetings will have priority over COMISAT for use of the conference room. In order to minimize disruption of course work, an effort will be made at Stockton to schedule staff meetings several days ahead. This would give the LS enough time to adjust trainee schedules for working in the center.

a. Preparation

By July 11, the Stockton ESO will also verify that two storage cabinets and a desk can be provided for the learning center. By August 20, the ESO will have equipped the learning center with storage cabinets for course materials and equipment, and a desk for the LS. As soon as the materials and equipment arrive, the ESO will have them stored in the learning center.

On August 29, a workshop dealing with the schedules and tasks of the personnel taking part in the demonstration will also address the scheduling of the learning center. Provision will be made for Fleet Center staff conferences. It is expected that there will be little variation from the agreed upon schedule.

b. Demonstration

The learning center will remain open 24 hours a day. However, when Fleet Center staff conferences are held all CMI activities will stop and CMI personnel will leave the conference room.

During the week, the LS will occupy the desk in the room from 0800 to 1600 hours. The rest of the time the ETs will be on call to come in and provide assistance.

The observations and periodic interviews of students and support personnel by PRC staff will provide data on the adequacy of the facility for the CMI course. By February 28, the equipment and materials will have been returned to CNTECHTRA, the Opscan/Terminet cluster shipped to MIISA, the phone line disconnected, and the storage cabinets and LS desk removed.

c. Evaluation

The assessment of facility needs will consider user satisfaction based on the interview results and observation by PRC staff. The adequacy of the space and organization of the room will be assessed. Inferences will be drawn on the requirements for an operational CMI system in the evaluation study to be completed May 19.

4. Print and Other Materials

The following materials will be provided by the agency indicated in parentheses:

- Ten copies of BE/E Course 69 core module (1-14) texts (CNTECHTRA)
- Short and long Opscan test answer sheets, lab sheets, administrative forms (P1, P2, P3), Terminet paper (CNTECHTRA)
- Student and Support personnel log sheets (PRC)
- Expendable supplies such as pens, pencils, paper (NAVCOMMSTA Stockton)

In addition, the ESO will order correspondence course material from the Naval Education and Training Program Development Center in Pensacola.

a. Preparation

By July 1, CNET will have tasked CNTECHTRA to provide 10 sets of Course 69 texts, modules 1-14, and enough test sheets, microfiche tests, lab papers, Opscan administrative forms (P1, P2, P3), and Terminet paper to support the experiment. These will be delivered by August 20, 1977, and stored in the learning center.

By July 25 the ESO will order the correspondence materials. They are to be delivered by August 23.

b. Demonstration

The students will be given access to the materials by the LS, or, when the LS is off duty, by the ETs substituting for the LS.

During the demonstration, the periodic interviews and observations by PRC staff will obtain information on any bottlenecks that may exist with respect to materials.

c. Evaluation

A judgment will be made by the PRC staff on whether or not the materials were adequate in number and availability. Implications might be drawn on requirements for an operational CMI system. However, the test case is small for this subject and it is doubtful strong conclusions can be reached. The analysis will be completed by June 9.

Chapter V

TASKING

A. Introduction

A successful demonstration will require coordination and support from a number of commands and operating units within the Navy. This chapter describes the specific tasking required within the Navy to carry out the demonstration.

B. Organizational Responsibilities

Within the Navy there are four groups involved in the tasking: CNET, COMNAVTELCOM, CNTECHTRA and NIISA.

CNET is responsible for preparing and issuing the tasking. The tasking for the communication lines has to be approved by OP-94 at COMNAVTELCOM.

COMNAVTELCOM will be responsible for approving the use of commercial leased lines to connect Stockton with San Diego, including the selection of modems to connect the lines with the terminal equipment. In gaining this approval, justification for the use of commercial lines instead of available Navy AUTODIN lines must be shown. The arguments presented in the preceding chapter and Appendix M on the selection of the communication line provide the basis for this justification.

CNTECHTRA will be responsible for providing a learning supervisor, the BE/E Course File 69 laboratory equipment, and the textbooks, test forms, answer sheets, and other materials related to the course. The costs associated with these items are to be covered by CNET.

MIISA will be responsible for providing specifications on the communication lines and modems, ordering and delivering the OPSCAN/TERMINET clusters, and providing student data both in preparation for and during the demonstration. Because of a change in ownership of the manufacturer of the OPSCAN equipment, MIISA will have to work out an agreement for the additional cluster. These negotiations may be lengthy and require an early start in order for the equipment to be ready for the demonstration.

Three types of student data are required from MIISA in order to efficiently carry out the demonstration. The first type consists of projections of time to completion for students with the skill levels representative of the volunteers at Stockton. This is to be obtained by enrolling the volunteers, if they are known, with names and social security numbers masked, or a fictitious set of students with representative aptitude levels. The immediate output of the CMI computer will provide an estimated time to completion. Once that is obtained, the enrollments, fictitious or actual, will be erased from the computer files pending enrollment of the final set of students at the beginning of the demonstration. The second type of data required is routine progress reports for the students actually enrolled in the demonstration. As indicated earliur these will be mailed by MIISA San Diego, initially twice a week and then on a weekly basis, to the learning supervisor at Stockton. The third set of data will contain information on the learning effectiveness control group and will be derived from historical data contained in the CMI computer at Memphis. Two steps are required to obtain that data. First, files will be searched to identify graduates of the BE/E Course File 69 with paygrade levels in the E4 to E6 group. Once a control group has been identified, performance data on time to completion will be obtained.

In addition to student data, MIISA personnel are to provide PRC with data on personnel time expended for the COMISAT project.

C. Tasking Letter

The tasking letter to be issued by CNET will:

- Set deadlines
- Initiate long lead-time activities
- Where additional work is required before requirements are completely known, allow resolution of details between the appropriate Navy group and the project staff at PRC

In addition, to ensure proper coordination of all activities, the letter should clearly specify communication links between the Navy groups participating in the demonstration, the PRC project staff, and CNET.

The tasking letters should detail the following activities to be carried out by each organization:

- MIISA
  - MIISA San Diego to register the students, and prepare and mail student reports twice a week for first month, weekly thereafter
  - MIISA Memphis to establish a Complex Identification Number for the Stockton trainees; estimate time to completion for a group of trainees representative of Stockton based on data supplied by PRC
  - All involved sections of MIISA to submit all costs and time charged to the project in a form suitable for analysis as specified by PRC
- CNTECHTRA
  - CMI System Manager to task MIISA to provide Stockton with two installed and operating OPSCAN/Terminet clusters by August 29, 1977. Delivery will take place by August 20, 1977

- CMI System Manager to task MIISA to lease, via COMNAVTELCOM, a two pair, type 3002, full duplex, unconditioned line from Stockton to San Diego. Bell 202-T modems should be used at each end of the line. The line will be activated August 29, 1977, at the latest

- CMI System Manager to task MIISA to have Honeywell install the RP6352 asynchronous line modulator at San Diego by August 29, 1977

- To provide 10 sets of Course 69 texts, modules 1-14, and enough test sheets, microfiche tests, lab papers, Opscan administrative forms (P1, P2, P3) and Terminet paper to support the experiment. These will be delivered by August 20, 1977

- To provide two full sets of NEAT testing boards on a no-cost loan, modified with a lock box covering the test control knobs; to provide the type and number of items of Course 69 lab equipment needed for 50 students. This will be delivered to Stockton by August 20, 1977

- To train and assign an LS to arrive at Stockton by August 20, 1977. The IT-BE/E training program will begin July 18, 1977. If necessary, more than one LS will be used in sequence to maintain a full time position

- To identify and maintain files on a control group for attitudes

- BE/E TPC to assist in identifying a group of 55 trainees to validate the attitude test at Great Lakes Training Center, 55 at Memphis. The contact at Great Lakes would be identified and all arrangements made by the TPC. This will begin by July 5, 1977

- To assign a staff member to oversee the setup of operations at Stockton. Dates to be specified

- To submit all costs and time charged to the project in a form suitable for analysis as specified by PRC

A sample translation of these requirements into a tasking letter is provided in Appendix N.

Chapter VI

DEMONSTRATION MASTER PLAN

This chapter chronologically describes the preparation, conduct, and evaluation of the demonstration from completion of this report to evaluation of the results of the demonstration. Figure VI-1 is a flow chart of the activities.

A. Preparation

Upon completion of the demonstration design, CNET will provide tasking for actions to be taken in preparation for the demonstration. These tasks are described in Chapter IV.

By July 11, the ESO at Stockton will provide PRC with a representative list of student characteristics based on the Chief's survey of potential volunteers for the CMI course. By July 15, MIISA Memphis will register these students in the BE/E Course File 69 to predict completion times. The students will then be dropped from the file and the results given to PRC staff for use in finalizing the demonstration schedule. The PRC staff will be at Memphis when the data are obtained.

Also by July 11, the ESO at Stockton will verify that two storage cabinets and a desk can be provided for the learning center. By July 15, the BE/E TPC at CNTECHTRA will assign an individual who is familiar with the BE/E Course File 69 as a CMI advisor to assist in setting up the demonstration at Stockton.

An LS will be identified by CNTECHTRA by July 11. Also by July 11, the BE/E TPC will arrange for the LS to begin any necessary IT-BE/E training on July 18.

By July 15, MIISA Memphis will complete contract negotiations with Honeywell for the following:

- Delivery of two Opscan/Terminet clusters to Stockton by August 20
- Installation and checkout of one cluster at Stockton by August 29
- Maintenance of the cluster on-call by Honeywell for the Terminet, by NCS for the Opscan
- Installation of the RP6352 asynchronous line modulator on the CMI concentrator at San Diego by August 29

By the same date, MIISA must initiate negotiations through COMNAVTELCOM for a contract with Pacific Telephone to provide a dedicated phone line between Stockton and San Diego.

The training of the LS at the training center in Memphis or San Diego BE/E school will begin July 18 and finish August 5. On the same day, PRC staff will begin a week-long validation of the attitude test with 55 students at the Great Lakes training center.

On July 18, MIISA Memphis will begin a file search of Course File 69 records to identify an historical set of control data for students with similar BTB scores and paygrades from E4 to E6. Upon completion of this search, PRC staff will screen the results and select a control group by July 29.

Beginning July 18, the ESO at Stockton will survey offsite personnel to determine the number who will take the BE/E correspondence course. On July 25, the ESO will order the necessary test and test materials from the Naval Education and Training Program Development Center in Pensacola.

During the week of July 25-29, PRC staff will administer the second stage of the attitude test validation to 55 CMI students at the Memphis training center.

On August 1, there will be two shipments: (1) the Opscan/Terminet clusters by Honeywell and NCS, and (2) Course 69 print material, lab equipment, and microfiche readers by CNTECHTRA. Also during this week the ESO at Stockton will finalize the list of volunteers for both the CMI course and the correspondence course.

On August 8, with student lists complete, the ESO at Stockton will prepare the needed registration information and provide copies to San Diego and the PRC staff who will be in Stockton August 8 through September 16.

Also on August 8, MIISA Memphis will establish a Complex Identification Number for the CMI learning center at Stockton and notify MIISA San Diego of the file number so the latter can handle administrative actions on the computer for Stockton.

On August 12, MIISA San Diego will register the Stockton CMI students and mail copies of the initial roster to the ESO at Stockton and to PRC in McLean, Virginia. The roster should be received at Stockton on Monday, August 15, at which time the ESO and the PRC staff at Stockton will schedule student course activities based on the estimated course completion time contained in the roster. A tentative schedule will be prepared by August 19, and revised in a planning session scheduled for August 29.

August 20 is the last day for arrival of the LS and the CMI advisor and delivery of the Opscan/Terminet clusters and the course materials and equipment. By then the ESO will have equipped the learning center with storage cabinets for course materials and equipment, and a desk for the LS. As soon as the materials and equipment arrive, the ESO will have them stored in the learning center.

The correspondence course materials are expected by August 23. On August 25, the LS and an ET will check the lab equipment and microfiche and arrange repair or replacements as needed.

By August 26, the PRC staff and the ESO will administer the attitude pretest and interview to the CMI students and key personnel.

Beginning the afternoon of August 29 and continuing throughout the week, the on-watch orientation meetings will be held with the ETs. These meetings, which will last three hours, will prepare the ETs for their roles as substitutes for the LS and as maintenance personnel for the lab equipment.

On August 29, Pacific Telephone will have an operating dedicated line, including modems, between Stockton and San Diego. Honeywell will have completed installation of the asynchronous line modulator to tie in the CMI concentrator in San Diego. Honeywell and NCS will also have completed installation and checkout of the cluster so there will be a fully operational CMI network on that date.

A workshop will be held on the morning of August 29 to develop a complete scheduling program for the operation of the CMI course. At this workshop, the LS, CMI advisor, PRC staff, Division Officers, Communications Officer, ESO, and DTC/POs from Stockton will develop a schedule for the LS and ETs over the expected duration of the course.

Beginning the afternoon of August 29 and continuing throughout the week, meetings will be held with the ETs to set student schedules. The PRC staff, the LS, the CMI advisor, and the Division Officers will participate.

Beginning the afternoon of August 30, and extending through September 2, the students will be briefed on the course. The students, ETs, DTC/POs, and ESO will be walked through the operations of the cluster and the use of the materials in the learning center by the LS and CMI advisors. These walkthroughs will be scheduled in the workshop of August 29 and coordinated to avoid conflict with the ET meetings.

B. Demonstration

Tuesday, September 6 will begin the demonstration. The LS or ET will initiate each student into the system as they arrive. For the duration of the course, the students will devote an average of two hours per watch to study, lab work, and exams. The last student is expected to finish by February 24. When the course begins there will be a revised estimate of the end date.

The correspondence course students will also begin on September 6 and are expected to finish in about 18 weeks, assuming an average of 10 hours per watch string. Allowing for holidays, they will finish by January 20. A revised estimate of completion will be made by the PRC staff for the August 30 workshop using time-to-completion estimates from MIISA.

The CMI course will operate under the direction of the LS, with the ETs substituting on administrative matters and technical questions when the LS is not on duty. The ETs will also maintain the lab equipment. Student progress reports in the form of learning center rosters will be provided on a weekly basis by MIISA San Diego. The reports will be printed and mailed Friday at San Diego for receipt by the LS at Stockton on Monday. During the first month, an additional roster will be mailed out on each Tuesday.

As the CMI course progresses, adjustments will be made to schedules and procedures for students and ETs. During the first two weeks, at least two meetings to discuss changes will be chaired by the LS. The participants will be the LS, CMI advisor, ESO, DTC/POs, Division Officers, Communications Officer, ETs, and PRC staff. PRC staff will observe the first two weeks of the course and develop an agenda for the first two meetings, plus an assessment on proposed changes to be discussed in the meetings. Improved schedules and procedures will be generated. After the first two weeks, monthly meetings will be scheduled to coincide with visits by PRC staff.

In order to gather data and information on costs, personnel time, and procedures, support personnel at Stockton (the LS, CMI advisor, ESO, DTC/POs, ETs, Division Officers, and Communication Officer) will maintain logs of their activities. The Division Officers and Communications Officer will note the time spent by any staff not keeping a log. These logs will be collected each Monday by the ESO and forwarded to PRC at McLean, Virginia.

MIISA personnel at San Diego and Memphis will also report time and activities devoted to the project. The Computer Center Director at MIISA San Diego will send a weekly report to PRC at McLean each Friday on costs and personnel time. The Deputy Director of MIISA at Memphis will report any significant costs or time spent on the demonstration in a weekly report.

In addition to the cost and time data, PRC will conduct routine interviews with CMI students and key support personnel to assess how well the demonstration is functioning in terms of personnel time, personnel training needs, organization and management structure, facilities, operational procedures, and logistics. These interviews will be given at the end of the first two weeks, the first month, and each month thereafter until the end of the demonstration.

The students in the correspondence course, which will run concurrently with the CMI course, will also work an average of 10 hours per watch string. There will be little formal interaction with support personnel in the correspondence course and the DTC/POs at the off-base site will forward student tests to the ESO, who will review them and, at the end of the course, forward them to Pensacola for grading. The ESO will assist the DTC/POs in counselling students having any problems.

Several specific events will occur during the demonstration.

- September 19 the CMI advisor will return to Memphis.
- PRC staff and the Stockton ESO and DTC/POs will administer the Stanford Diagnostic Reading Test to CMI students during the week of October 3-7, and to correspondence students during the week of October 10-19. The results will be used in assessing CMI student performance in the BE/E course 69 and both groups on the special achievement.
- Tests and interviews to evaluate attitudes will be administered to a control group of experienced personel attending a CMI course from a land site. The dates and location will be set by PRC and CNTECHTRA, with completion expected by November 15. Since the students will be working full-time on the course, the time between the pretests and the final posttests may be as little as six weeks. The control group testing and interviewing is expected to be completed by the end of December. By December 15, the special exam to be used in comparing the effectiveness of the CMI and correspondence courses will be designed.
- At the completion of the correspondence course (expected to end by January 20, 1978), the ESO will complete the student files and send a summary of student time-to-complete and total performance scores to PRC at McLean by January 27.

The demonstration will be closed down by February 28, 1978. On February 24 the last student is expected to log out, and on February 27 MIISA San Diego will mail out the Graduate Performance Summary and Attrition Student Performance Summary to PRC at McLean and the LS at Stockton. The ESO will collect and forward to PRC the remaining time and cost logs.

The Opscan/Terminet cluster will be disconnected by Honeywell and NCS on February 28 and the units shipped to a site designated by MIISA. Also by February 28th, the dedicated phone line will be disconnected by Pacific Telephone, the ESO at Stockton will ship the Course 69 materials and equipment back to CNTECHTRA at Memphis, the learning center will have the cabinets and LS desk removed, and the LS will leave Stockton to report for new duty elsewhere. The LS will have completed the CMI student files and submitted all the appropriate records to CNTECHTRA in Memphis. The ESO will keep whatever is desired for Stockton files.

For each CMI student, the attitude tests and interviews will be administered by PRC staff, or the ESO and DTC/POs, within one week following completion. On February 28, the test and interview will be administered by the PRC staff to key support personnel.

C. Evaluation

After the demonstration, PRC staff will analyze the results in terms of the eight research objectives. In addition, during the week from February 7 to March 3 the special achievement exams will be taken at Stockton by the CMI and correspondence students. The performance of these groups will be analyzed by PRC staff.

PRC will have the following data and information in hand and tabulated by March 10:

- CMI time to completion
- Special exam scores
- Attitude test scores for both students and key personnel
- Attitude interviews for both students and key personnel
- Cost data
- Personnel time data and activity descriptions
- Equipment and Logistics Usage
- Interviews with students and key personnel on the operation of the CMI course

A total of four weeks will be required to analyze the data related to learning effectiveness and attitudes. The effectiveness will be accomplished by running a standard covariance analysis package on the PRC computers in McLean to compare CMI student performance at Stockton to the historical Course File 69 data obtained from MIISA Memphis. Results will be obtained by March 24.

The attitude pretest and posttest data from the experimental CMI group at Stockton will be compared to the data from the CMI control group. A covariance analysis will also be run on the PRC computers, with results obtained by March 31. The interview answers will be used to adjust the interpretation of the statistical analysis of the test scores. All the attitude analyses will be completed by April 14.

Costs and personnel time data will be used to assess the cost effectiveness of CMI onsite training for the Navy and the Department of Defense. The cost of major CMI onsite activities will be estimated and compared to conventional approaches. This work will be completed by June 1.

The remaining objectives concern personnel, personnel training, organization, and procedural and logistics requirements, and will be dealt with in that order. Each uses the personnel time data and the interview information on problems faced and actual or potential solutions identified. A case study approach will be used to assess:

- Operational effectiveness of the demonstration design
- Desirable or required changes to achieve an effective operational system

Personnel and personnel training requirements will be studied and conclusions reached by April 7. The organization and management structure requirements will be studied next, with results by April 28. Facility and procedure requirements will be assessed by May 19, equipment and logistics requirements by June 9.

The complete report on the demonstration will be presented in draft form July 15, 1978.

Appendices

Appendix A

PRESENT VALUE ANALYSIS

When two programs have different cash flows over time, a basis of comparison is needed other than the yearly costs or savings. Present value concept provides such a basis. It represents the current value of a cost or savings that will occur at a specified future time.

Because it is possible to invest money and obtain income from it, receiving $1,000 today is worth more than receiving $1,000 two years from now. Specifically, assume that a 10 percent annual rate of return can be obtained for carefully invested money. $1,000 today would be worth $1,210 ($1,000 x 1.1 x 1.1) at the end of two years. Therefore, $1,000 is the present value of the $1,210 received at the end of two years.

When deciding between alternative cash flows, it is preferable to choose the alternative with the highest present value, all other factors being equal. For example, consider an offer of $900 now or $1,210 in two years. The present value of $1,210 is $1,000 and is larger than the $900 offer. Based on present value it would be preferable to wait two years for the $1,210. The choice is confirmed by considering that the $900 invested now would yield only $1,089 in the same time period.

Costs are treated in exactly the same manner. The present value of spending $1,210 at the end of two years is $1,000. If the choice were to spend $1,100 now or wait two years and spend $1,210, all other things being equal, it would be preferable to wait two years before spending the money.

No matter what the cash flow over time, positive or negative, it can be reduced to a present value by the formula.

$$PV = X(0) + \frac{X(1)}{(1+r)} + \frac{X(2)}{(1+r)^2} + \cdot\cdot\cdot + \frac{X(n)}{(1+r)^n} + \cdot\cdot\cdot$$

where $X(n)$ = cash flow in year n

r = average rate of return for the year

The term discount rate is used instead of rate of return in the more general consideration of public investments and in particular in Defense Department applications. Discount rate will be used in the remainder of this discussion. Often, the cash flow is uniform over a year. If r is the rate of return for a full year

$$PV = X(0) + \frac{X(1)}{(1+\frac{r}{2})} + \frac{X(2)}{(1+\frac{r}{2})^2} + \frac{X(n)}{(1+\frac{r}{2})^n} + \ldots$$

When the cash flows are identical from year to year and are represented by a_c

$$PV = a_c \left(1 + \frac{1}{(1+\frac{r}{2})} + \frac{1}{(1+\frac{r}{2})^2} + \ldots + \frac{1}{(1+\frac{r}{2})^n} + \ldots \right)$$

Sometimes, when a fixed present investment is being compared to a cash flow over time, the equivalent annual cash flow is desired. That is given by

$$a_c = \frac{PV}{1 + \frac{1}{(1+\frac{r}{2})} + \frac{1}{(1+\frac{r}{2})^2} + \ldots + \frac{1}{(1+\frac{r}{2})^n} + \ldots}$$

The selection of a discount rate r, is very important in analyzing present value. A change in r could change the choice of program. For Defense Department programs, Reference 3 specifies a value of 10 percent.

For COMISAT, a program life of eight years (corresponding to the life of the terminals) was selected. For any component of the program, such as an individual course or terminal, the present value is calculated as follows

$$PV = a_o + \frac{a_c}{(1+\frac{r}{2})} + \frac{a_c}{(1+\frac{r}{2})^2} + \ldots + \frac{a_c}{(1+\frac{r}{2})^8}$$

$$= a_o + 5.597(a_c)$$

Where a_o is the fixed investment, a_c the annual cost, the discount rate is 10 percent and the program life is eight years.

Because the CMI courses have a life of 12 years, there is some value remaining at the end of the eight year program. Assuming uniform depreciation over 12 years, one third of the initial investment remains at the end of eight years. That value could be transferred to another program if COMISAT ended and CMI continued at the training centers, or it could be charged to later years of an extended COMISAT operation along with other annual costs and savings. Hence the present value of the remaining equity is an equivalent savings. If the developing and coding cost is

$$a_o = \$522,750$$

as it is for a course 51 days in length, then the remaining equity at the end of eight years is $a_o/3 = \$522,750/3 = \$174,250$, and the present value of this equity is

$$PV_8\ (a_o/3) = 0.4665\ (\$174,250) = \$81,288$$

Consistent with the Defense Department instructions of Reference 3, the present value concept was used to describe the projected net benefits of COMISAT. The reader is referred to that document for further information on conducting and presenting economic analysis results for Defense Department programs.

Appendix B

REQUIRED AUTODIN II CAPACITY

As discussed in TAEG Report Number 44 (page 219), each 10 student hours of training will require a transmission of 1,067 characters from the remote site to the CMI Computer and 9,174 characters from the CMI Computer back to the remote site. These transmission requirements assume a batching of 10 messages together to increase communication efficiency.

For purposes of determining the size of the transmission line required to and from the CMI Computer, the larger of the two transmission requirements must be used. Using the characteristics of the representative COMISAT program of Table II-1, the number of student training hours per year is:

$$(20{,}881 \text{ students/year})(.967)(255 \text{ hours})^{1} = 5{,}148{,}941 \text{ student training hours per year}$$

Thus, the total number of characters per year to be transmitted to the CMI Computer center is:

$$\frac{(5{,}148{,}941)(9{,}174)}{10} = 4{,}723{,}638{,}473 \text{ characters per year}$$

$$= 150 \text{ characters per sec.}$$

---

[1] Assuming an average course length of 255 hours.

This transmission requirement should then be converted into an appropriate sized transmission link between the nearest AUTODIN switch and the CMI Computer and the cost of such a link calculated. Incidently the net cost of the AUTODIN lines required should be calculated as the difference between the total cost of the AUTODIN lines and the cost of the additional dedicated lines required to operate the CMI skill progression courses at the training centers. Neither of these costs is available at this time.

Similar calculations could be made for the additional transmission requirements the COMISAT system imposes on the message center at each remote site. For the 538 sites included in the representative case this amounts to an average additional load of 0.28 characters per second.

Appendix C

U. S. NAVY TRAINING WORKLOADS

FY 76 through FY 80

Table C-1. DoD Individual Training and Education Program Information—Initial Skill

Reporting Services: U.S. Navy
Program VIII-T ______
Non-Program VIII-T ______

Training Category: Specialized Skill
Sub Category: Initial Skill
Sub-Sub-Category: Enlisted

Symbol: C-1
Submittal Date ______

DOD Individual Training and Education Program Information

Part A: Students/Trainees (Unites)	Actual FY 76			Estimated FY 7T			Estimated FY 77			Estimated FY 78			Projected Loads	
	Entrants	Grads	Loads	Entrants	Grads	Loads	Entrants	Grads	Loads	Entrants	Grads	Loads	FY 79	FY 80
1. Training Loads														
Active	1611770	159861	20428	37405	32810	17001	166900	165024	20225	164102	162287	19722	19719	19715
(PCS)	(155629)	(153874)	(19844)	(35983)	(31563)	(16513)	(160543)	(158723)	(19643)	(157833)	(156073)	(19152)	(19147)	(19143)
(TDY) (TRAVEL)	(6141)	(6087)	(584)	(1422)	(1247)	(488)	(6357)	(6201)	(582)	(6269)	(6214)	(570)	(572)	(572)
(TDY) (NON TRAVEL)	( )	( )	( )	( )	( )	( )	( )	( )	( )	( )	( )	( )	( )	( )
Reserve	2839	2782	311	385	422	252	2989	[illegible]	311	3323	3257	405	392	392
Total Authorizations	164609	162743	20739	37790	33232	17253	169889	[illegible]	20536	167425	165544	20127	20111	20107
2. Workload														
Active	(161770)	(159861)	(20428)	(37405)	(32810)	(17001)	(166900)	(165024)	(20225)	(164102)	(162287)	(19722)		
(By Army)	(944)	(875)	(262)	(249)	(228)	(228)	(1065)	(996)	(288)	(1085)	(996)	(288)		
(By USMC)	( )	( )	( )	( )	( )	( )	( )	( )	( )	( )	( )	( )		
(By Air Force)	(218)	(192)	(47)	(72)	(66)	(66)	(278)	(245)	(62)	(249)	(219)	(56)		
(By Non-DOD)	( )	( )	( )	( )	( )	( )	( )	( )	( )	( )	( )	( )		
(By Non Serv DOD Agy)	( )	( )	( )	( )	( )	( )	( )	( )	( )	( )	( )	( )		
By Reporting Service	160608	158794	20119	37084	32516	16707	165557	163783	19875	162708	161072	19378		
For Army	720	668	318	174	115	147	719	667	327	580	547	268		
For USMC	18862	17492	1322	3568	3402	1033	17765	16551	1480	19413	18087	1565		
For Air Force	1	1		1	2									
For USCC	1211	1262	112	209	280	108	981	914	95	1582	1474	160		
For DOD Civ	645	649	9	551	564	3	823	821	2	624	622	2		
For Non DOD Civ	5	7	1		1									
For Non US	1876	1984	477	463	416	320	3198	2720	812	3524	2987	895		
Reserve	2839	2782	311	385	422	252	2989	2935	311	3323	3257	405		
Supernumerary			2879			2133			2580			2420		
Total Workload	184567	183730	25648	42424	37708	20703	192032	188381	25442	191844	189056	25093		

Footnotes

Table C-2. DoD Individual Training and Education Program Information—Skill Progression

Reporting Services: U.S. Navy
Program VIII T
Non-Program VIII T

Training Category: Specialized Skill
Sub Category: Skill Progression
Sub-Sub-Category: Enlisted

Symbol: C.2
Submittal Date

DOD Individual Training and Education Program Information

Part A. Students/Trainees (Units)	Actual FY 76			Estimated FY 7T			Estimated FY 77			Estimated FY 78			Projected Loads	
	Entrants	Grads	Loads	Entrants	Grads	Loads	Entrants	Grads	Loads	Entrants	Grads	Loads	FY 79	FY 80
1. Training Loads														
Active	61316	60108	9720	15255	15163	9085	62723	61354	9895	62909	61666	9800	9896	9942
(PCS)	(29977)	(29271)	(7261)	(7594)	(7408)	(6770)	(30766)	(29819)	(7426)	(30042)	(29336)	(7274)	(7370)	(7416)
(TDY) (TRAVEL)	(31339)	(30837)	(2459)	(7661)	(7755)	(2315)	(31957)	(31535)	(2469)	(32867)	(32330)	(2526)	(2526)	(2526)
(TDY) (NON-TRAVEL)	( )	( )	( )	( )	( )	( )	( )	( )	( )	( )	( )	( )	( )	( )
Reserve	424	413	39	159	158	36	547	539	55	475	467	37	37	37
Total Authorizations	61740	60521	9759	15414	15321	9121	63270	61893	9950	63384	62133	9837	9933	9979
2. Workload														
Active	(61316)	(60108)	(9720)	(15255)	(15163)	(9085)	(62723)	(61354)	(9895)	(62909)	(61666)	(9800)		
(By Army)	(250)	(216)	(74)	(109)	(81)	(87)	(604)	(552)	(167)	(530)	(485)	(141)		
(By USMC)	(1524)	(1423)	(182)	(539)	(546)	(260)	(1327)	(1322)	(129)	(128)	(121)	(10)		
(By Air Force)	(379)	(340)	(62)	(73)	(98)	(67)	(395)	(356)	(63)	(395)	(356)	(63)		
(By Non DOD)	( )	( )	( )	( )	( )	( )	( )	( )	( )	( )	( )	( )		
(By Non-U.S.)	( )	( )	( )	( )	( )	( )	( )	( )	( )	( )	( )	( )		
(By Non Serv DOD Agy)	( )	( )	( )	( )	( )	( )	( )	( )	( )	( )	( )	( )		
By Reporting Service	59163	58129	9402	14474	14438	8671	60397	59124	9536	61856	60704	9586		
For Army	440	425	87	104	70	52	642	491	202	543	499	118		
For USMC	5884	5753	600	1201	1307	443	7257	6946	880	7041	6740	641		
For Air Force	581	552	113	86	108	82	568	528	150	525	488	97		
For USCG	663	700	121	128	140	78	1360	1306	222	1438	1380	266		
For DOD Civ	1070	1057	114	230	240	107	1020	1006	108	1010	996	108		
For Non DOD Civ	71	70	13	11	8	7	85	64	14	85	64	14		
For Non US	1452	1443	291	326	345	302	1782	1770	356	2209	2194	441		
Reserve	424	413	39	159	158	36	547	539	55	475	467	37		
Supernumerary			783			743			688			695		
Total Workload	69558	68542	11563	16719	16814	10521	73638	71774	11991	75164	73532	12001		

Footnotes

Table C-3. DoD Individual Training and Education Program Information––Functional

Reporting Service U.S. Navy
Program VIII-T
Non-Program VIII T
Training Category Specialized Skill
Sub-Category Functional
Sub-Sub-Category
Symbol C.3
Submittal Date

DOD Individual Training and Education Program Information

Part A: Students/Trainees (Units)	Actual FY 76			Estimated FY 7T (3 mo.)			Estimated FY 77			Estimated FY 78			Projected Load	
	Entrants	Grads	Loads	Entrants	Grads	Loads	Entrants	Grads	Loads	Entrants	Grads	Loads	FY 79	FY 80
1. Training Loads														
Active	349681	340007	4047	91570	90259	3876	351912	342584	4094	352015	342679	4097	4099	4099
(PCS)	(22105)	(21314)	(1198)	(5890)	(5891)	(1110)	(22246)	(21631)	(1218)	(22226)	(21611)	(1224)	(1226)	(1226)
(TDY) (TRAVEL)	(327153)	(318270)	(2842)	(85597)	(84285)	(2760)	(329230)	(320517)	(2867)	(329340)	(320619)	(2863)	(2863)	(2863)
(TDY) (NON-TRAVEL)	(423)	(423)	(7)	(83)	(83)	(6)	(436)	(436)	(9)	(449)	(449)	(10)	(10)	(10)
Reserve	13838	14579	124	3954	3886	133	16696	16546	134	17003	16859	136	136	136
Total Authorizations	363519	354586	4171	95524	94145	4009	368608	359130	4228	369018	359538	4233	4235	4235
2. Workload														
Active	(349681)	(340007)	(4047)	(91570)	(90259)	(3876)	(351912)	(342584)	(4094)	(352015)	(342679)	(4097)		
(By Army)	(1742)	(1614)	(484)	(411)	(378)	(377)	(1798)	(1681)	(486)	(1798)	(1681)	(486)		
(By USMC)	( )	( )	( )	(3)	(3)	( )	( )	( )	( )	( )	( )	( )		
(By Air Force)	( )	( )	( )	( )	( )	( )	( )	( )	( )	( )	( )	( )		
(By Non DOD)	( )	( )	( )	( )	( )	( )	( )	( )	( )	( )	( )	( )		
(By Non-U.S.)	( )	( )	( )	( )	( )	( )	( )	( )	( )	( )	( )	( )		
(By Non Serv DOD Agy)	( )	( )	( )	( )	( )	( )	( )	( )	( )	( )	( )	( )		
By Reporting Service	347939	338393	3563	91156	89878	3499	350116	340903	3608	350219	340998	3611		
For Army	4272	4263	45	1173	1140	52	4437	4427	45	4541	4531	49		
For USMC	16197	16264	194	4210	4240	203	16879	16269	206	16870	16261	206		
For Air Force	974	974	16	217	217	15	971	971	18	1003	1003	20		
For USCG	6260	6287	54	1985	1943	67	1981	6964	59	6915	6900	59		
For DOD Civ	11192	11249	142	1994	1986	103	10650	10628	141	10767	10745	151		
For Non DOD Civ	9819	9814	63	1398	1396	80	9286	9264	63	9599	9576	67		
For Non US	3832	3817	35	774	763	37	3491	3473	31	3136	3121	26		
Reserve	13838	14579	124	3954	3886	133	16696	16546	134	17003	16859	136		
Supernumerary			118			232			120			120		
Total Workload	414323	405640	4354	106861	105429	4421	419507	409445	4425	420053	409994	4445		

Footnotes

Appendix D

ESTIMATION OF COURSE ENROLLMENT DATA

As mentioned in Chapter II, the data on individual enrollments for skill progression courses was limited to the title, length, and number of graduates of the 10 courses with the highest volume. The lack of data necessitated generation of populations for courses and approximation of such enrollment quantities as average attendance and student man-days. This appendix provides further details about the procedures used to arrive at these estimates.

A. Generating Course Populations

The basic assumption underlying the generation of estimates of course volumes is that the derived populations have the same properties, i.e., can be fitted by the same curve, as the populations of the 10 highest volume courses. With this assumption, the required populations can be obtained by fitting a curve through the populations for the 10 highest volume courses and extrapolating this curve to obtain the needed populations. These steps are described in greater detail below.

1. Fitting the Curve

As Figure D-1 illustrates, the course populations seem to follow an exponential curve. A learning curve was used to approximate these populations because such a curve is exponential in shape, is relatively simple to derive and manipulate, and provides a close approximation to the data. This appendix contains a discussion of the learning curve and its properties.

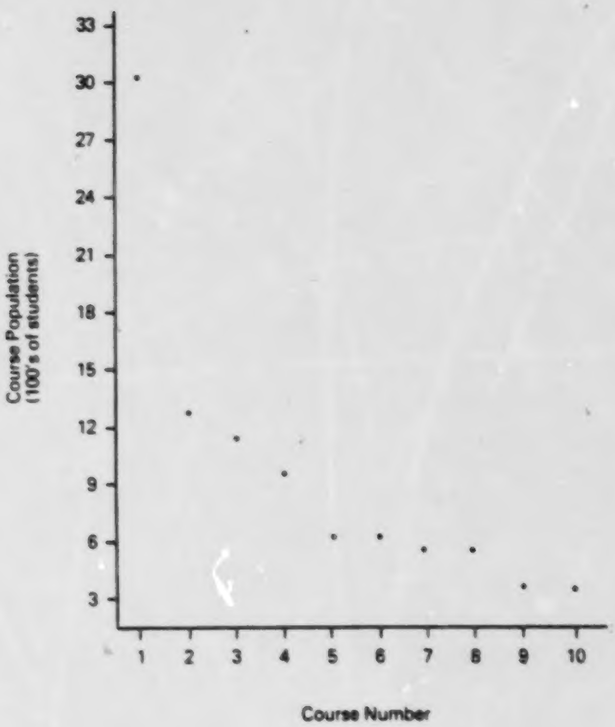


Figure D-1. Population Plot of the 10 Highest Volume Courses

A process follows a learning curve if the accumulated average of the dependent variable decreases to a constant percentage of the previous accumulated average value whenever the independent variable is doubled. For example, if the populations of the high volume courses follow a learning curve, then, by doubling the number of courses, the accumulated average student population is decreased to a constant percent of the previous accumulated average population. The constant percentage mentioned above is called the learning rate. A learning curve with a 70 percent learning rate is plotted in Figure D-2.

To determine if the course population data follows a learning curve the accumulated average populations for each course were

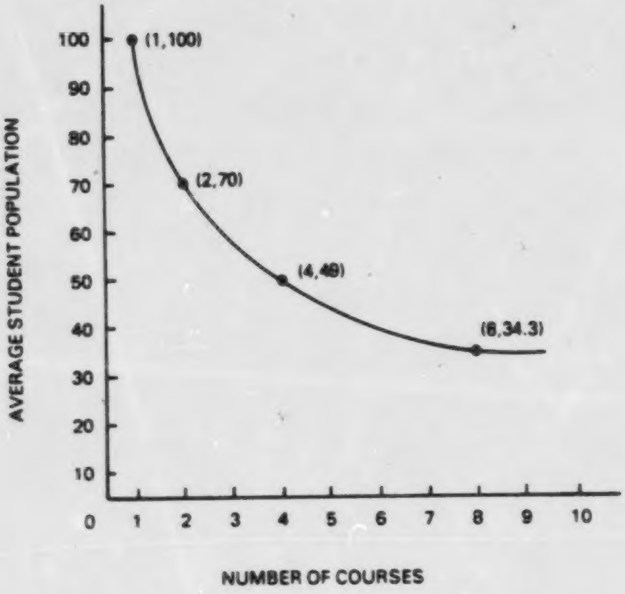


Figure D-2. 70 Percent Learning Curve

Table D-1. Actual Cumulative and Course Populations

(1) Highest Volume Course Number	(2) Sums	(3) Accumulated Average
1	3,110	3,110
2	4,433	2,216.5
3	5,607	1,869
4	6,567	1,641.75
5	7,178	1,435.6
6	7,786	1,297.67
7	8,372	1,196
8	8,884	1,110.5
9	9,285	1,031.67
10	9,685	968.5

determined and used to examine the learning rate. Table D-1 contains these accumulated average populations, which were found by dividing the cumulative population by the course number. The learning rate can now be estimated by performing the calculations given below where A_i is the accumulated average population of the i^{th} course.

$$\frac{A_2}{A_1} = 71\%$$

$$\frac{A_4}{A_2} = 74\%$$

$$\frac{A_6}{A_3} = 69\%$$

$$\frac{A_8}{A_4} = 68\%$$

$$\frac{A_{10}}{A_5} = 67\%$$

It was noted that all of these ratios are fairly close to 70 percent. In fact, their average is 69.8 percent. Hence, a 70 percent learning curve seemed to provide a reasonable approximation to the course population data and was used in obtaining subsequent course populations.

The next step in arriving at these course populations was to determine the algebraic form of the particular learning curve to be used. The algebraic form of a general learning curve is

$$Y_N = \frac{a}{N^b}$$

where, for purposes of this analysis, Y_N is the accumulated average number of students over N courses; a is the number of students in course 1; N is the number of courses; and *b* is an exponent associated with the learning rate. In this equation Y_N and N are variables, *a* is a constant whose value is known to be 3110, and *b* is a constant whose value must be derived.

To derive *b* the learning curve formula was first applied to the second and fourth courses, which yields

$$Y_2 = \frac{3110}{(2)^b}$$

and

$$Y_4 = \frac{3110}{(4)^b}$$

respectively. Dividing the first of these equations by the second results in

$$\frac{Y_2}{Y_4} = \frac{3110/(N)^b}{3110/(2N)^b} = (2)^b = \frac{1}{.70}$$

due to the relationship between the accumulated average populations. Applying the logarithm function to both sides of the equation, the value of *b* was found to be .516. Hence, the specific form of the learning curve which was applied in this analysis is

$$Y_N = \frac{3110}{N^{.516}} \quad .$$

2. Extrapolating the Curve

The accumulated average population for the eleventh and subsequent courses can be determined by substituting the course number for N in the formula previously derived. These results are shown in Column

2 of Table D-2 for courses 10 through 18. However, the course population, not the accumulated average course population, is required. Course population can be obtained from the accumulated average population by employing the following steps:

- For course 10 and all subsequent courses, multiply the accumulated average by the course number, N, to find the cumulative number of students in each of the N courses. The results of these calculations are shown in Column 3 of Table D-2.
- Subtract the cumulative population for the N-1st course from the cumulative population for the Nth course to find the number of students taking the Nth course. The resulting course enrollments can be found in Column 4 of Table D-2.

Table D-2. Approximate Cumulative and Course Populations

(1) N Course Number	(2) Accumulate Average	(3) Fitted Cumulative	(4) Course Population
10	947.9	9,479	
11	902.4	9,926	447
12	862.8	10,353	427
13	827.9	10,762	409
14	796.8	11,155	393
15	768.9	11,534	379
16	743.8	11,900	366
17	720.9	12,255	355
18	699.9	12,598	343

B. Approximation of Enrollment Quantities

Two enrollment quantities were approximated in this analysis: average attendance and student man days.

1. Average Attendance

The average number of people enrolled in a course at any given time was determined from the number of graduates, using data from Table II-5. The average number of students is:

$$\frac{\text{entrants + graduates}}{2} = \frac{62{,}909 + 61{,}666}{2} = 62{,}287$$

Average attendance can be obtained from the number of graduates by:

$$\frac{\text{total average attendance}}{\text{total number of graduates}} \text{(number of graduates in the course)}$$

$$= \frac{62{,}287}{61{,}666} \text{(course graduates)} = 1.01 \text{ (course graduates)}$$

2. Student Man Days

The number of student man-days required by a course was determined by multiplying the average attendance by the course length. With the exception of courses one through ten, all courses were assumed to require 51 days, the average course length for skill progression courses.

The results obtained by these procedures were used in the economic analysis in Chapter II.

Appendix E

DETAILS OF THE CALCULATION OF COSTS, SAVINGS, BREAK-EVEN POPULATIONS

The components of costs and savings were described in general terms in Chapter II. This appendix presents the details of the techniques used to calculate each cost element so that the reader may verify the analytical results.

A. Costs and Savings Incurred Through Development of CMI Courses for Training Center Use

1. Course Development, Coding and Maintenance

As discussed in Chapter II, developing a course for CMI instruction and coding it for use on the computer requires an incremental expenditure of $2,050 per hour of training. The number of training hours in a course was determined by first multiplying the number of calendar days by 5/7, to obtain the number of working days required by the course. Multiplying the result by 7, the number of training hours in a day, yielded the hours of training required by a course. The development and coding cost were then found by:

Development and coding cost per course:

$$= (\$2{,}050)\ (\text{calendar days})\ (5/7)\ (7) \qquad [1]$$

$$= (\$10{,}250)\ (\text{calendar days})$$

The annual course maintenance cost was estimated by taking five percent of this incremental expense of development and coding.

2. Computer Expansion Cost

The components of computer expansion costs were also discussed in Chapter II and an annual cost of $14,400 for each thousand AOB students was determined. AOB can be found by dividing the average annual attendance by the number of successive courses in a year, which is 365 divided by the course length in calendar days. Therefore, AOB is:

$$(\text{average annual attendance}) \left(\frac{\text{course length in days}}{365}\right)$$

and annual computer leasing cost is:

$$\left(\frac{\$14{,}400}{1{,}000}\right) (\text{average annual attendance}) \left(\frac{\text{course length in days}}{365}\right)$$

$$= \$.0395\ (\text{average annual attendance})(\text{course length in days}) \qquad [2]$$

3. Terminal Costs

For each 60 AOB students taking CMI at the training center an additional terminal must be purchased and maintained. Assuming courses can share terminals, the number of training center terminals required to service a course can be found by dividing the number of AOB students in the course by 60.

The investment and maintenance costs of a training center terminal, from Table II-7 in Chapter II, are $14,250 and $147/month respectively. The eight year present value of total cost of one training center terminal is:

$$\$14{,}250 + 5.597(\$147)\ 12 = \$24{,}123.$$

Therefore, the present value of a training center terminal cost for any course can be found by :

$$\frac{\text{Course AOB}}{60}\ (\$24{,}123) \qquad [3]$$

4. Savings in Student Time and Living Costs

The saving in student man-hours of training with CMI compared to conventional training is the product of the number of AOB students, the percentage of time saved by CMI, and the annual rate of pay for each student. The annual salary, including basic pay, quarters, incentive and special pay, retirement pay, and miscellaneous expenses, was assumed to be $10,090, the salary of a student with an E-4 rating. As indicated in Chapter II, a 20 percent decrease in training time was assumed. Thus, the annual saving in student salary is:

$$(\text{AOB})\ (.20)\ (\$10{,}090) = \$2{,}018\ (\text{AOB}) \qquad [4]$$

Incremental living savings was derived in a similar manner by multiplying the average annual number of students, average number of days saved, and incremental living expense saved. The average number of days saved was calculated as the product of the number of calendar days in a course and the 20 percent time savings factor. The incremental living cost saved is $2.50 per day. So the annual living cost savings was determined by:

$$\begin{aligned}&(\text{average number of students})\ (.20)\ (\text{calendar days})\ (\$2.50)\\ &= \$.50\ (\text{average number of students})(\text{calendar days}) \qquad [5]\end{aligned}$$

B. COMISAT Costs and Savings for Training Center Justified Courses

1. Terminal Cost

In order to teach the first 17 courses through COMISAT, the only costs are for terminal purchase and maintenance. For the low maintenance case, the undiscounted terminal investment cost is the number of sites multiplied by the unit terminal price of $11,450. For the high maintenance case with assignment of spare terminals, the same calculation is made but the number of terminals to be purchased is increased by the spares.

Spare parts investment cost was determined similar to terminal cost, using a spare parts unit cost of $6,529. The discount for a particular number of terminals or spare parts sets was found by taking the sum of the discounts in Table II-10, weighted by the number of units in each discount group. For example, if 80 units are needed the total discount is:

0(1) + 5%(29) + 10%(30) + 15%(20) = 745% of the unit terminal cost. The group and cumulative discounts can be found in Table E-1.

Table E-1. Group and Cumulative Quantity Discounts

Units	Percent Discount	Number in Group	Group Discount (%)	Cumulative Discount (%)
1st	0	1	0	0
2nd - 30th	5	29	145	145
31st - 60th	10	30	300	445
61st - 90th	15	30	450	895
91st - 120th	20	30	600	1,495
121st - 150th	25	30	750	2,245
151st - 180th	30	30	900	3,145
181st - 210th	35	30	1,050	4,195
211th - up	40	n	40n	4,195 + 40n

2. Maintenance Costs

Maintenance costs depend on the site category and the maintenance assumptions of each case. However, with the exception of Category 1, (CONUS sites 50 miles or less from a service location) unit maintenance rates for the high maintenance case can be obtained from those of the low maintenance case by multiplying by 4/3 for land sites and 6/4 for ship sites. Hence, this discussion will be concerned only with the low maintenance case.

Category 1 sites would be serviced by Opscan at a cost of $80 per month or $960 per year. Category 2 sites (CONUS sites between 50 and 90 miles from service) would also be maintained by Opscan but on a time-and-materials basis which involves costs of travel, labor and parts. Travel charges are 18 cents per mile plus $30 per hour of travel for each failure. If an average travel speed of 45 mph is assumed, the average total travel cost per year would be:

(number of annual breakdowns) ($.18) (miles to the site) + (number of annual breakdowns) (1/45) ($30) (miles to the site).

Since this cost will vary with the distance to the site, a mean travel cost of $2,218 for all sites in this category was calculated. Labor cost is $30 per hour and the mean time to repair is 2 1/2 hours; thus the average annual labor cost is:

($30) (2 1/2) (number of annual breakdowns) = $75 (number of annual breakdowns)

The only information available concerning the cost of parts was Opscan's price of $600 for a service warranty for the second year. This was taken as the annual parts cost. Naval personnel would service all other remote (Category 3, 4, and 5) sites, thereby incurring costs of labor and parts. The total labor cost per repair for service by site personnel was assumed to be the same as Opscan's total labor cost.[1] Therefore, labor cost is, as before:

$75 (number of annual breakdowns).

The average annual cost of replacing used parts from the inventory, based on a failure rate of three per year, was estimated by assuming that Opscan's $600 per year warranty price was derived on the basis of the price for parts used and their expected return on investment for a perpetual inventory. It was further assumed that they require a 30 percent return on their parts investment of $6,529 and that this inventory is used by the Opscan repairmen in servicing 10 sites. The desired return on investment is $1,960 or approximately $200 per year per site. Thus, the average cost of parts to the Opscan company is $400 per year for each terminal when three annual failures occur. The same parts cost was assumed for service by Navy personnel.

3. COMISAT Savings

The savings achievable by utilizing COMISAT to teach the first 17 courses consist of three components: student travel, living expense at the training center, and the cost of terminals no longer required at the training center. The average cost of a one-way trip to a training center is $137. In addition, a student on PCS is allowed $291 to cover transfer of household effects. Thus, the total travel costs saved per student for PCS and for TDY are, respectively:

$141.50 + $291 = $432.50 and
2($141.50) = $283.

---

[1] This is a conservative assumption, permitting the ET to take a longer mean time to repair than the Opscan repairman since the ET's hourly cost is less.

The average travel cost, taking into account the relative frequency of PCS and TDY[1] is:

$$\left(\frac{30,042}{62,909}\right)(\$432.50) + \left(\frac{32,867}{62,909}\right)(\$283) = \$354.39\text{/entrant, or}$$

$$\left(\frac{62,909}{61,666}\right)(\$354.39) = 1.02(\$354.39) = \$361.48\text{/graduate.}$$

The total travel savings is:

$$(\$361.48)\ (\text{number of graduates}). \qquad |6|$$

The living savings is the product of the number of student-days and $2.50, the daily living allowance at the training center. There is a savings of one training center terminal for every 60 AOB students reached through COMISAT. Each training center terminal requires a $14,250 investment and a present value cost of $9,873 to maintain over eight years. Hence the savings in training center terminals is:

$$\frac{\text{AOB}}{60}(\$14,250 + \$9,873) = \$402.05\ \text{AOB}. \qquad |7|$$

C. Calculation of Break-Even Populations

In order to determine which sites should be outfitted with COMISAT terminals it was necessary to calculate the population for which the cost of delivering training to the site is equal to the savings achieved, because all site populations greater than this would result in savings. This section describes the derivation of the break-even population for each cagegory of site.

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[1] The data in the proportions come from Table II-5.

The formula used to derive the break-even population is:

$$P_{be} = TC_{pv}E/TGS_{pv}$$

where P_{be} = break-even population

TC_{pv} = present value of equipment

E = enlisted personnel population

TGS_{pv} = present value of travel and living savings

The present value of total gross travel and living savings for those courses economically justified for use at the training centers was found to be $23,714,343 when discounted at 10 percent over eight years. The total enlisted personnel population (E) was given as 370,346. Thus, the only quantity needed to determine the break-even population (P_{be}) was the present value of the total cost of a site (TC_{pv}) discounted over eight years. TC_{pv} is the sum of the terminal and spare parts cost without quantity discounts, and the eight year present value of maintenance. Two factors, total number of terminals purchased and site category, influence the value of TC_{pv}. For this reason, a different break-even population was calculated for each category within each case.

The only exception to the calculation of break-even population by site category occurs in Category 2, where the dependence of maintenance cost of mileage makes calculation of one TC_{pv} for the entire category impossible. As a result, decisions about the inclusion of Type 2 sites were made by comparing the total cost of each particular site to the savings which it could contribute.

Since quantity discounts are available for terminals and spare parts, the investment cost, and hence the total cost, depends on the numbers of terminal and parts sets required. For this reason, the calculations were made iteratively using the following steps:

- Estimate the discount intervals in which the number of terminals and the number of parts sets will fall.
- Using these estimates determine the correct quantity discount factor from Table II-10.
- Use the discount factors to derive a quantity discounted investment cost of a terminal and a spare parts set.
- Determine TC_{py} by adding the investment costs to the maintenance cost for the category under consideration
- Use the equation given above to derive P_{be}.
- Compare the site populations to P_{be} to identify sites whose population is larger than P_{be}. These are the sites feasible for COMISAT development. If the number of terminals and spare parts are within the estimated intervals, the correct break-even populations have been calculated. Otherwise, revise the interval estimates as indicated and repeat the process.

This procedure resulted in the identification of 306 feasible sites requiring an expenditure of $5,348,000 in present value over eight years.

D. Costs and Savings in the Iterative Approach

1. Costs

For courses whose development is justified only by COMISAT, the cost of development, coding, maintenance, leasing, site terminals, and the cost of additional training center terminals required by students who can't be reached by COMISAT must all be charged to COMISAT. With the exception of training center costs, each of these is calculated as described in Sections A and B of this appendix. Terminal costs for implementing 70 percent of the 18th and subsequent courses at the training center are derived similar to the savings discussed in Section B. However, the number of students who must take the new courses at the training center (AOB_s) is used in the formula. Thus, the training center terminal cost charged to COMISAT is:

$$\left(\frac{AOB_s}{60}\right)(\$14,250 + \$9,873)$$

where AOB_s is the number of students who cannot be reached at their own sites by the 18st and subsequent courses.

The gross COMISAT cost for teaching all economically and operationally feasible courses at Navy sites is summarized in Table II-4 and can be found by evaluating the following expression:

> Eight year present value of COMISAT gross cost = (development and coding for courses justified only by COMISAT [1])+ (computer leasing [2]) + (course maintenance for courses justified only by COMISAT) + (COMISAT terminals) + (training center terminals [3]).

Applying the appropriate formula for each cost yields:

Eight year present value of COMISAT gross cost =

$$.7(N-17)(2,050)(51)(5/7)(7) - .7(N-17)(\$81,288) +$$

$$.7(N-17)(5.597)(.05)(522,750) + \left(\frac{14,400}{1,000}\right)(g_{\Delta N})(1.01)\left(\frac{51}{365}\right) +$$

$$\text{COMISAT terminal cost} + \frac{g_{\Delta N}(1.01)\left(\frac{51}{365}\right)(PC)}{60}(\$14,250 + \$9,873),$$

where N is the total number of economically feasible courses of which 70 percent can be converted to CMI, $g_{\Delta N}$ is the number of graduates in the 70 percent of Courses 18 through N convertible to CMI, and PC is the percent of the population which cannot be reached onsite through COMISAT. The above expression can be simplified to:

Eight year present value of COMISAT gross costs =

$411{,}426N + 11.4\, g_{\Delta N} + 57(g_{\Delta N})\ (PC)$ + COMISAT terminal cost

2. Savings

The savings COMISAT achieves through development of additional courses consist of travel, living, time, and incremental living savings. Each of these is calculated using formulas discussed previously in this appendix.

The gross COMISAT savings for teaching 70 percent of the N highest volume courses at remote sites is:

> Eight year present value of gross COMISAT savings = (travel cost for students of all courses as indicated in equation [6]) + (living costs for students of all courses) + (time costs for students of courses 18 to N as indicated in equation [4]) + (living costs for students of courses 18 to N as indicated in equation [5]) + (training center terminal costs for students who are taught Courses 1 to 17 through COMISAT as indicated in equation [3]).

Substituting the proper formulas into this expression yields:

Eight year present value of gross COMISAT savings =

$(5.597)(1-PC)\ (\$361.48)\ (g) + 5.597(1-PC)\ (\$2.50)\ (51)\ (g)\ (.80) +$

$(5.597)\ g_{\Delta N}(1.01)(51/365)(.20)(\$10{,}090) +$

$g_{\Delta N}(1.01)(.20)(51)(\$2.50)(5.597) +$

training center terminal costs

where g is the total number of graduates in the N courses convertible to CMI.

This expression simplifies to:

Eight year present value of gross COMISAT savings = $2,594\ g - 2,594\ g\ (PC) + 1,741\ g_{\Delta N}$ + training center terminal cost.

Subtracting the gross savings expression from the gross cost expression results in net cost. A simplified expression for net cost in terms of N can be obtained by using the identities:

$$g_{\Delta N} = .7\ (3,110\ N^{.484} - 3,110(17)^{.484})$$

$$= 2,177N^{.484} - 8,578$$

But, by definition,

$$g = 9,334 + g_{\Delta N}$$

$$= 2,177N^{.484} + 756$$

The simplified net cost expression is:

Eight year present value of net COMISAT cost = $411,426N - 6,107,356N^{.484} + 2,342,017N^{.484}PC + 850,425PC + 7,497,450$ + COMISAT terminal cost + training center terminal cost.

PC, COMISAT terminal cost, and training center terminal cost are known once the number of sites is fixed. Thus, net cost is a function of the single variable N.

The expression for net cost is useful in two ways. First, by taking its derivative, setting the result to zero, and solving for N, the maximum number of courses which could be justified for CMI is obtained. The net cost expression can also be rewritten in terms of the student time saving and operational constraint parameters. With the expression in this form the sensitivity of total cost to the parameters can be easily investigated. The results of this sensitivity analysis were shown for the low maintenance case in Table II-3. Similar results for the high maintenance case can be found in Table E-2.

Table E-2. Sensitivity of Present Value Savings to Time Savings and CMI Convertibility Assumptions: High Maintenance Case

Percentage of Skill Progression Courses Convertible to CMI	Percentage of Student Time Saved		
	10%	15%	20%
60%	$14,466,000	$18,079,000	$21,691,000
70%	$18,423,000	$22,637,000	$26,852,000
80%	$22,379,000	$27,196,000	$32,012,000

Appendix F

DETERMINATION OF MAXIMUM MILEAGE FOR MAINTENANCE BY OPSCAN PERSONNEL

In order to determine the total maintenance costs, a decision must be made regarding which CONUS sites should be serviced by Opscan personnel and which by Naval (ET) personnel. The cost of service by an ET is constant within each of the maintenance cases defined in the report, and the cost of Opscan service varies only with the mileage to the site from the service location. Hence, all sites beyond a determined distance from service should have site personnel handle repairs; all other CONUS sites should be serviced by Opscan.

The break-even mileage for each case can be determined by performing the following steps. The low maintenance case data are used as an illustrative example.

- Sum the costs of parts, labor, and inventory investment to arrive at an eight year present value cost of ET repair.

  Cost of parts for ET repair = \$400/year

  Cost of labor for ET repair = 3(2.5)\$30 = \$225/year

  Inventory Investment = \$6,529

  Eight year present value cost of ET repair = \$6,529 + 5.597 (\$625)

  = \$10,027

- Sum the costs of parts, labor, and mileage to arrive at an expression for the eight year present value cost of Opscan service as a function of miles to the site.

  Cost of parts for Opscan service = \$600/year

Cost of labor for Opscan service = 3(2.5)\$30 = \$225/year

Cost of mileage for Opscan service = (\$.18)(6)d + (1/45)(6)(\$30)d

= \$1.08d + \$4d

= \$5.08d

where d is the mileage from the service location to the site.

Eight year present value cost of Opscan service

= 5.597(\$825 + \$5.08d)

= \$4,617 + \$28.43d

- Equate these two costs.

\$10,027 = \$4,617 + \$28.43d

- Solve the resulting equation from the desired mileage.

$$d = \frac{\$10,027 - \$4,617}{\$28.43}$$

d = 190 miles

Similar calculations for the high maintenance case result in equally high mileages. However, response time for this distance would be several hours. To reduce the terminal down time to more reasonable limits, a maximum distance of 90 miles, with a two hour driving time, was chosen.

Appendix G

AIRLINE SCHEDULE OF TARIFFS[1]

The following is the current procedure used by all airlines to calculate the gross fare including tax as a function of flight distance.

1. Insert a fixed Base Terminal charge of $16.05.

2. Add to this a series of cumulative charges relating to the flight distance involved[2], as follows:
   0 - 500 miles: $ .0877/mi.
   501 - 1500 : $ .0669/mi.
   1501 + : $ .0643/mi.

3. Next include the 8% tax by multiplying the calculated rate by 1.08 and round up or down to the nearest dollar.

4. From this total fare, the airline receives the total fare divided by 1.08. The U.S. Government receives the remaining, e.g., calculate the fare on a flight of 1,500 miles:

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[1] Reference Civil Aeronautics Board, Bureau of Tariff

[2] If a carrier flies nonstop, the point distance is used. If the flight has intermediate stops, the mileage between the two points consists of the sum of the most direct logs available. However, if another airline has a direct flight at a lower cost, the competing airline will reduce his rate to that of the nonstop airline to compete.

1.	$16.05
2.	$43.85
	$66.90
Total	$126.80

3. (1.08) ($126.80) = $136.94 which is rounded up to $137.

4. From this the airline receives: $137/1.08 = $126.85 and the remainder ($10.15 is the tax).

Appendix B
RESEARCH DESIGN DATA FORMS

The appendix contains:

- The Student Registration Card
- The Attitude Survey Instruction Script
- The Data Tally Sheet
- Data Input Format: Attitudes

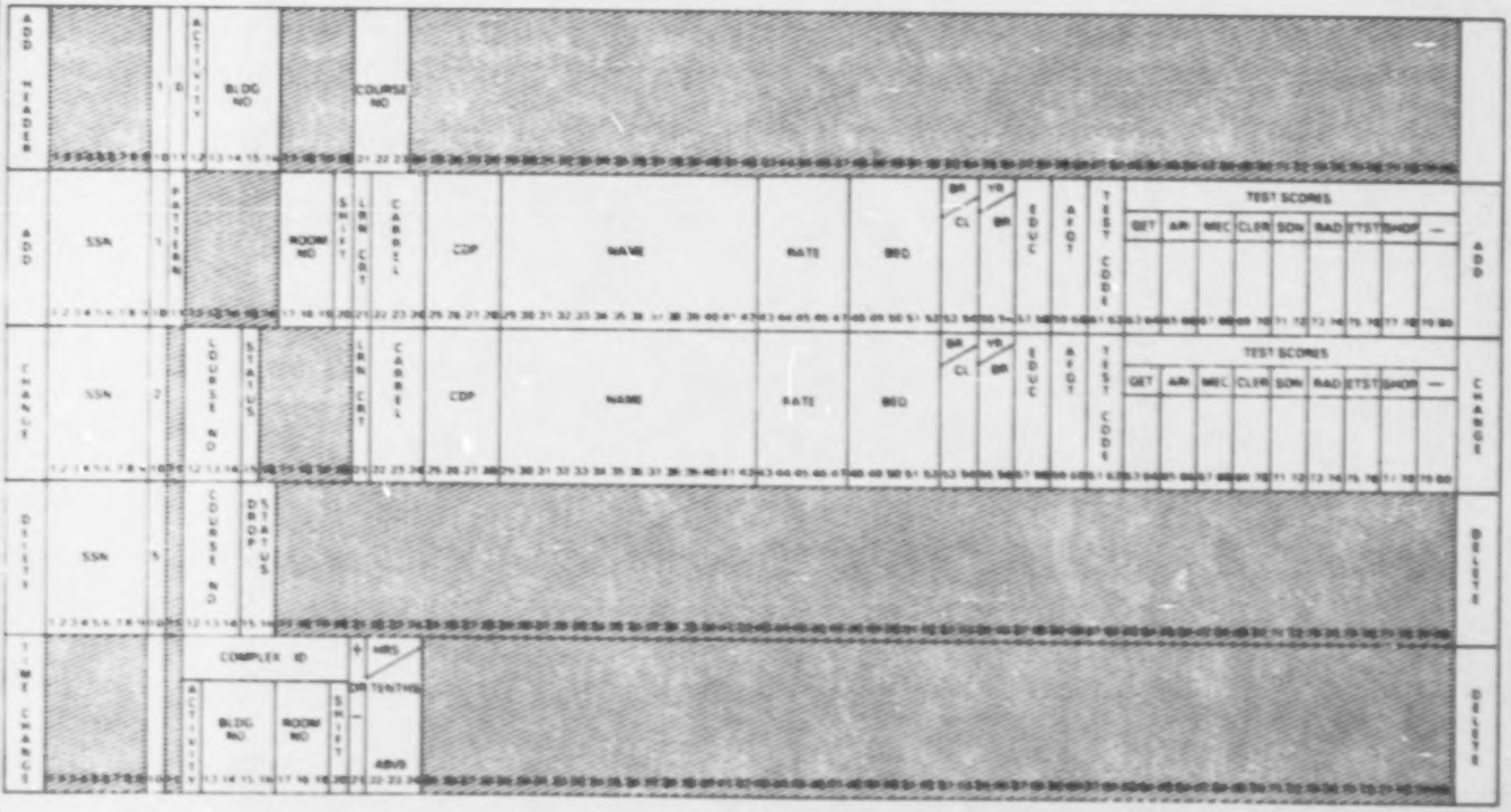

Figure H-1. Student Registration Card

ATTITUDE SURVEY INSTRUCTIONS

You are about to complete a survey designed to help the Navy get information about your feelings toward the training you are currently receiving at this command. Before you complete the survey, we would like to ask you to take a few minutes to read the information and directions on the first page of the booklet.

Remember, this is not a test; there are no right or wrong answers. Your survey will be scored by personnel outside of this command and only statistical group results will be shown to anyone in your command. We are interested in your honest feelings about the training program. After reading the directions for this survey, if you have any questions, please don't hesitate to ask before you start the survey. Take your time but try to answer each item with your immediate feelings. Answer each item as honestly as you can. Remember, there are no right or wrong answers, we just want to know how you feel.

Group ____________________

Date ____________________

Code ____________________

Name	Combined BTB Score			Reading Ability Grade Level			Attitude 1 Pre		Attitude 2 Pre		Attitude 3 Pre		Attitude 4 Pre		Attitude 5 Pre		Attitude 6 Pre		Attitude 7 Pre		BE&E Course Total Time To Reach Criterion				Comprehensive E.E. Test Score			Attitude 1 Post		Attitude 2 Post		Attitude 3 Post		Attitude 4 Post		Attitude 5 Post		Attitude 6 Post		Attitude 7 Post		Group #	Sex								
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	

Figure H-2. Data Tally Sheet

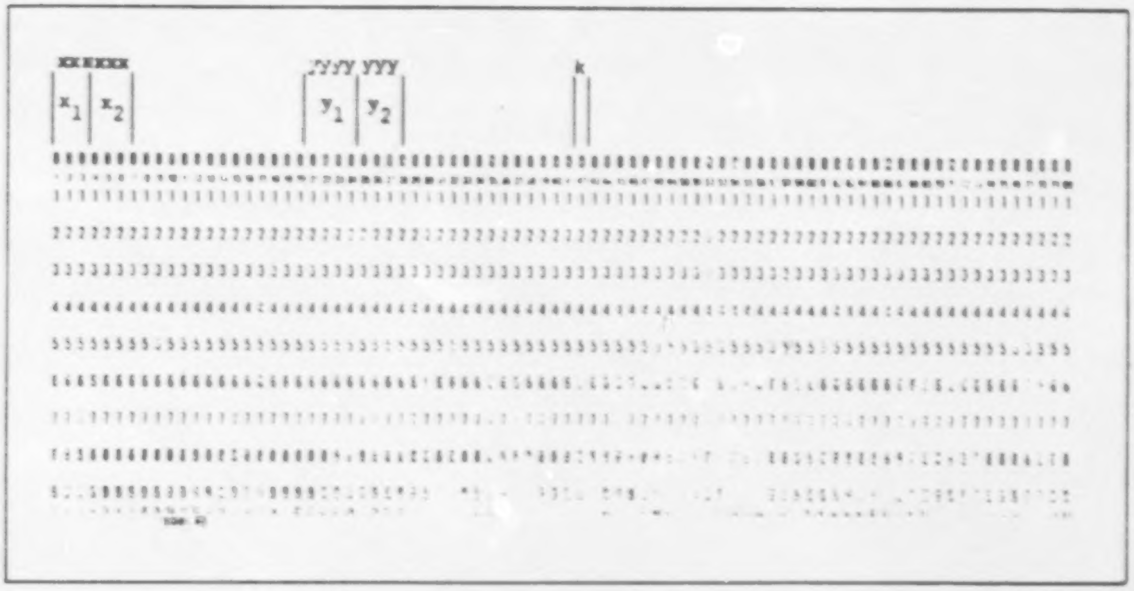

Figure H-3. Data Input Format: Course Performance

where x = the covariate entries

x_1 = BTB score

x_2 = reading ability scores

y = the dependent measure entries

y_1 = BE/E course performance

y_2 = special electricity and electronics exam score

k = group identification (CMI, correspondence, no formal training)

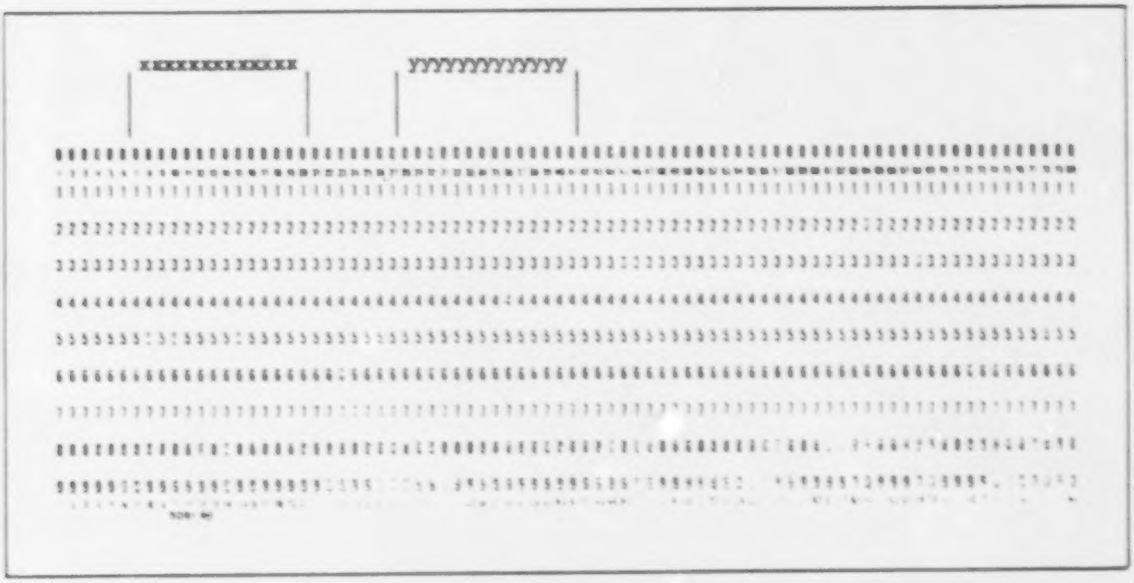

Figure H-4. Data Input Format: Attitudes

where x = covariates (pretest attitude scores for each attitude component)

y = dependent measures (posttest attitude scores for each attitude component)

Appendix I
INTERVIEW INSTRUMENTS

This appendix contains:

- The Semantic Differential Survey Instrument for Students
- The Semantic Differential Survey Instrument for Key Support Personnel
- The Post Interview Questions for Students and Key Personnel

Appendix I, Exhibit 1

THE SEMANTIC DIFFERENTIAL SURVEY

INSTRUMENT FOR STUDENTS

DIRECTIONS: On the following pages we are asking you to rate your feelings toward a number of concepts/things related to your training. In accordance with SECNAVINST 5211.5 of 14 Aug 1975, information included in the CMI survey is requested under the authority of ____________________ Departmental Regulations. This information is required to assist in the evaluation of the CMI System. You are not required to provide this information, but you can be assured that your individual answers will be kept completely confidential and no attempt will be made to evaluate you or the command you are currently with based on your answers.

On the following pages you are asked to rate your feelings on the following concepts: COURSE MATERIAL, COMPUTER MANAGED INSTRUCTION, LEARNING SUPERVISOR, STUDY CENTER, CMI TESTING PROCEDURES, CONTENT OF CMI TEST FEEDBACK, CMI TEST FEEDBACK TIME.

Here is how to use the scales:

If you feel the scale relates very closely to your feelings mark it as such:

strong ___X___ : _______ : _______ : _______ : _______ : _______ : _______ weak

or

strong _______ : _______ : _______ : _______ : _______ : _______ : ___X___ weak

If you feel the scale relates quite closely to your feelings mark it as such:

strong _______ : ___X___ : _______ : _______ : _______ : _______ : _______ weak

or

strong _______ : _______ : _______ : _______ : _______ : ___X___ : _______ weak

If you feel the scale relates only slightly to your feelings mark it as such:

strong _______ : _______ : ___X___ : _______ : _______ : _______ : _______ weak

or

strong _______ : _______ : _______ : _______ : ___X___ : _______ : _______ weak

If you feel you are neutral or feel the scale is not relevant to your feelings, mark it as such:

strong _______ : _______ : _______ : ___X___ : _______ : _______ : _______ weak

PLEASE REMEMBER THE FOLLOWING:

1. Mark all scales; do not skip any.
2. Place your mark in the middle of each line, not in between lines.
3. Work quickly and do not put more than one mark for each scale.
4. Please be sure that you have filled in the necessary information on the cover page of the survey.

THE LEARNING SUPERVISOR

informed ______:______:______:______:______:______:______ uninformed

bad ______:______:______:______:______:______:______ good

available ______:______:______:______:______:______:______ unavailable

valuable ______:______:______:______:______:______:______ worthless

effective ______:______:______:______:______:______:______ ineffective

inexpert ______:______:______:______:______:______:______ expert

helpful ______:______:______:______:______:______:______ obstructive

unqualified ______:______:______:______:______:______:______ qualified

unreliable ______:______:______:______:______:______:______ reliable

unorganized ______:______:______:______:______:______:______ organized

Comments: Please comment on what it is that you like best about the concept you have rated above and what it is you like least.

Like best:

Like least:

Other comments (use other side if necessary):

THE COURSE MATERIAL

like ______:______:______:______:______:______:______ dislike

valuable ______:______:______:______:______:______:______ worthless

inadequate ______:______:______:______:______:______:______ adequate

meaningful ______:______:______:______:______:______:______ meaningless

boring ______:______:______:______:______:______:______ interesting

frustrating ______:______:______:______:______:______:______ motivating

bad ______:______:______:______:______:______:______ good

unorganized ______:______:______:______:______:______:______ organized

approve ______:______:______:______:______:______:______ disapprove

useful ______:______:______:______:______:______:______ useless

Comments: Please comment on what it is that you like best about the concept you have rated above and what it is you like least.

Like best:

Like least:

Other comments (use other side if necessary):

THE STUDY CENTER

cramped ______:______:______:______:______:______:______ roomy

satisfactory ______:______:______:______:______:______:______ unsatisfactory

uncomfortable ______:______:______:______:______:______:______ comfortable

dislike ______:______:______:______:______:______:______ like

organized ______:______:______:______:______:______:______ unorganized

pleasant ______:______:______:______:______:______:______ unpleasant

noisy ______:______:______:______:______:______:______ quiet

disapprove ______:______:______:______:______:______:______ approve

adequate ______:______:______:______:______:______:______ inadequate

awful ______:______:______:______:______:______:______ nice

Comments: Please comment on what it is that you like best about the concept you have rated above and what it is you like least.

Like best:

Like least:

Other comments (use other side if necessary):

COMPUTER MANAGED INSTRUCTION CMI

like ______:______:______:______:______:______:______ dislike

valuable ______:______:______:______:______:______:______ worthless

adequate ______:______:______:______:______:______:______ inadequate

meaningless ______:______:______:______:______:______:______ meaningful

interesting ______:______:______:______:______:______:______ boring

frustrating ______:______:______:______:______:______:______ motivating

good ______:______:______:______:______:______:______ bad

unorganized ______:______:______:______:______:______:______ organized

disapprove ______:______:______:______:______:______:______ approve

useless ______:______:______:______:______:______:______ useful

Comments: Please comment on what it is that you like best about the concept you have rated above and what it is you like least.

Like best:

Like least:

Other comments (use other side if necessary):

CMI TESTING PROCEDURES

inefficient ______:______:______:______:______:______:______ efficient

disapprove ______:______:______:______:______:______:______ approve

right ______:______:______:______:______:______:______ wrong

effective ______:______:______:______:______:______:______ ineffective

organized ______:______:______:______:______:______:______ unorganized

dislike ______:______:______:______:______:______:______ like

vague ______:______:______:______:______:______:______ clear

fair ______:______:______:______:______:______:______ unfair

bad ______:______:______:______:______:______:______ good

adequate ______:______:______:______:______:______:______ inadequate

Comments: Please comment on what it is that you like best about the concept you have rated above and what it is you like least.

Like best:

Like least:

Other comments (use other side if necessary):

CONTENT OF CMI TEST FEEDBACK

good ______:______:______:______:______:______:______ bad

dislike ______:______:______:______:______:______:______ like

unfair ______:______:______:______:______:______:______ fair

sufficient ______:______:______:______:______:______:______ insufficient

useless ______:______:______:______:______:______:______ useful

adequate ______:______:______:______:______:______:______ inadequate

valuable ______:______:______:______:______:______:______ worthless

irrelevant ______:______:______:______:______:______:______ relevant

approve ______:______:______:______:______:______:______ disapprove

unimportant ______:______:______:______:______:______:______ important

Comments: Please comment on what it is that you like best about the concept you have rated above and what it is you like least.

Like best:

Like least:

Other comments (use other side if necessary):

CMI TEST FEEDBACK TIME

effective ______:______:______:______:______:______:______ ineffective

fast ______:______:______:______:______:______:______ slow

bad ______:______:______:______:______:______:______ good

unpredictable ______:______:______:______:______:______:______ predictable

regular ______:______:______:______:______:______:______ irregular

consistent ______:______:______:______:______:______:______ inconsistent

inefficient ______:______:______:______:______:______:______ efficient

reliable ______:______:______:______:______:______:______ unreliable

insufficient ______:______:______:______:______:______:______ sufficient

inadequate ______:______:______:______:______:______:______ adequate

Comments: Please comment on what it is that you like best about the concept you have rated above and what it is you like least.

Like best:

Like least:

Other comments (use other side if necessary):

Appendix I, Exhibit 2

THE SEMANTIC DIFFERENTIAL SURVEY INSTRUMENT FOR KEY SUPPORT PERSONNEL

DIRECTIONS: On the following pages we are asking you to rate your feelings toward a number of concepts/things related to your training. In accordance with SECNAVINST 5211.5 of 14 Aug 1975, information included in the CMI survey is requested under the authority of ____________________ Departmental Regulations. This information is required to assist in the evaluation of the CMI System. You are not required to provide this information, but you can be assured that your individual answers will be kept completely confidential and no attempt will be made to evaluate you or the command you are currently with based on your answers.

On the following pages you are asked to rate your feelings on the following concepts: COURSE MATERIAL, COMPUTER MANAGED INSTRUCTION, LEARNING SUPERVISOR, STUDY CENTER, CMI TESTING PROCEDURES, CONTENT OF CMI TEST FEEDBACK, CMI TEST FEEDBACK TIME. (All but the STUDENT questions are the same as the forms for the student survey instrument. Therefore only the STUDENT question sheet is included in this exhibit.)

Here is how to use the scales:

If you feel the scale relates very closely to your feelings mark it as such:

strong X : ______ : ______ : ______ : ______ : ______ : ______ weak

or

strong ______ : ______ : ______ : ______ : ______ : ______ : X weak

If you feel the scale relates quite closely to your feelings mark it as such:

strong ______ : X : ______ : ______ : ______ : ______ : ______ weak

or

strong ______ : ______ : ______ : ______ : ______ : X : ______ weak

If you feel the scale relates only slightly to your feelings mark it as such:

strong ______ : ______ : X : ______ : ______ : ______ : ______ weak

or

strong ______ : ______ : ______ : ______ : X : ______ : ______ weak

If you feel you are neutral or feel the scale is not relevant to your feelings, mark it as such:

strong ______ : ______ : ______ : __X__ : ______ : ______ : ______ weak

PLEASE REMEMBER THE FOLLOWING:

1. Mark all scales; do not skip any.
2. Place your mark in the middle of each line, not in between lines.
3. Work quickly and do not put more than one mark for each scale.
4. Please be sure that you have filled in the necessary information on the cover page of the survey.

THE STUDENTS YOU HAVE WORKED WITH DURING THIS TRAINING PERIOD

qualified ______:______:______:______:______:______:______ unqualified

stupid ______:______:______:______:______:______:______ intelligent

skilled ______:______:______:______:______:______:______ unskilled

foolish ______:______:______:______:______:______:______ wise

unreliable ______:______:______:______:______:______:______ reliable

adequate ______:______:______:______:______:______:______ inadequate

ineffective ______:______:______:______:______:______:______ effective

dislike ______:______:______:______:______:______:______ like

superior ______:______:______:______:______:______:______ inferior

good ______:______:______:______:______:______:______ bad

Comments: Please comment on what it is that you like best about the concept you have rated above and what it is you like least.

Like best:

Like least:

Other comments (use other side if necessary):

Appendix I, EXHIBIT 3
POST INTERVVIEW QUESTIONS FOR STUDENTS AND KEY PERSONNEL

1. CMI Concept Questions.

Generally, how do you feel about the idea of computer managd instruction (CMI)?

How would you compare CMI to other forms of Naval training you have had in the past?

Why did you decide to take this course?

Have you ever taken any other computer managed instruction type course? If so, what was it?

If the opportunity presented itself, would you take another CMI course?

+ ______ : ______ : ______ : ______ : ______ : ______ : ______ -

2. Study Center Questions.

Generally what are your feelings about this training center (schoolhouse)?

Were there any problems in the study center that you feel are serious enough to be mentioned now?

+ ______ : ______ : ______ : ______ : ______ : ______ : ______ -

3. Testing/Study Procedure Questions.

Generally, what is your feeling about the testing procedure for this course?

Generally, how do you feel about the feedback you received?

Generally, how do you feel about the feedback time interval -- the time between taking a test and getting back your test results -- during the course?

Generally, how do you feel about the time interval between study sessions during the course?

+ ______ : ______ : ______ : ______ : ______ : ______ : ______ -

4. Learning Supervisor Questions.

Generally, how do you feel about the learning supervisor for this course?

How do you feel about the help you received from your learning supervisor during the course?

Did you feel comfortable when consulting with your learning supervisor during the course?

+ ______ : ______ : ______ : ______ : ______ : ______ : ______ -

5. The CMI Course and Course Material Questions.

What are some of the things you like best about the course and training you have received here?

What are some of the things you like least about the course and training you have received here?

Was the training you received adequate? Did the course meet your needs? (If not, why?)

How was your motivation during the course?

How do you feel about the instructional materials that were used for the course (PI books, etc.)?

How did you find the instructional materials in terms of your reading and understanding?

How do you feel about the practical 'hands on' materials in the course?

+ ______ : ______ : ______ : ______ : ______ : ______ : ______ -

6. Operational/Procedural Questions.

Generally, how do you feel about the idea of taking technical training at an operational site as compared with taking technical training at a designated technical school?

If given the choice, which would you prefer:

- Training at your tour station?
- Or training at a special technical school?

How did you find this course in relation to your regular assigned work duties?

Did you run into any problems while taking the training which you feel are serious enough to be mentioned?

Generally, how do you feel about taking a technical course in preparation for your rate advancement exam?

All in all, how did the training you received here affect you in terms of your job? Your career advancement? Any other ways that you can think of?

+ ______ : ______ : ______ : ______ : ______ : ______ : ______ -

7. General Demographic Questions.

How long have you been in the Navy?

How long have you been at this site?

How long have you been at this paygrade/rank?

Describe what you do on your job.

Before your present position/job what did you do?

What other kinds of technical training have you had at particular schools--training centers?

Appendix J

STUDENT, KEY PERSONNEL AND MAINTENANCE LOGS

This appendix contains samples of the following forms:

- CMI Student Time Record
- Summary of Correspondence Student Progress
- Key Personnel Time Log
- Maintenance Log

Figure J-1. Student Time Record

Student Name	Social Security Number	Week Ending
John Jones	222-22-2222	01/06/78

Day	Watch (mid, Day, Eve)	Study			Lab				Test			
		Start	End	Total	No.	Start	End	Total	No.	Start	End	Total
Sat.	(Enter x for extra study time off duty)											
Sun.												
Mon.												
Tues.												
Wed.												
Thurs.												
Fri.												

Figure J-2. Summary of Correspondence Student Progress

Date ____________________

BE/E Correspondence Courses

Name	Social Security Number	Total Study Time to Date (hours)	Present Lesson Number

Figure J-3. Key Personnel Time Log

Name	Position	Week Ending
George Jones	LS	01/06/78

Day	Substantive Activity	Hours	Administrative Activity	Hours	Unusual Events
Sat.					
Sun.					
Mon.					
Tues.					
Wed.					
Thurs.					
Fri.					

Figure J-4. Maintenance Log

Equipment (Type, I.D. Number)	Date/Time Maintenance Called	Date/Time Maintenance Technician Arrival	Date/Time Repairs Complete	Remarks
				(LS or ET to fill in suspected cause; technician to describe actual cause)

Note: Two looseleaf binder files will be kept, one for maintenance of the communications system, the other for maintenance of lab equipment. Both will be kept at the LS's desk.

Appendix K

SUPPORT REQUIREMENTS--INTERVIEW QUESTIONS

As discussed in the chapter on demonstration design, key site personnel and students will be interviewed to assess the support requirements for operational CMI systems. The requirements of concern are:

- Personnel
- Personnel training
- Organization and management structure
- Space requirements and operational procedures
- Equipment, maintenance, spare parts and logistics requirements

These correspond to five of the research objectives of the demonstration. Based on the issues involved in determining these requirements, interview questions have been developed for each of the following:

- Commanding Officer, Communications Officer, Division Officers, watch supervisors, chiefs of the watch, and leading chiefs
- ESO, DTC/POs, LS, and CMI advisor
- ETs
- Students

The interviews will be given at the end of the first two weeks of the demonstration, at the end of the first month, and once a month after that until the end of the demonstration.

INTERVIEW QUESTIONS: Commanding Officer NAVCOMMSTA Stockton
Communications Officer
Division Officers
Watch Supervisors
Chiefs of the watch
Leading chiefs

1. Are you satisfied with the progress to date of the COMISAT demonstration?

2. Do you feel that you have been adequately informed regarding the status of the demonstration? If not, what change in reporting is desirable?

3. Have you been properly informed of problems with the demonstration?

4. Do you feel the additional workload imposed on base personnel by the demonstration is acceptable? What changes would you recommend?

5. Have communication operations been affected by the existence of the demonstration? If so, how? What changes would you recommend for the CMI demonstration to avoid a negative effect on operations?

6. Are you satisfied with the manner in which your direction or suggestions regarding demonstration activities have been carried out? Are there any issues of communication problems or divided authority that should be resolved?

7. Are there any other problems you would like to discuss? Do you have any suggestions for dealing with them?

INTERVIEW QUESTIONS: ESO
DTC/POs
LS
CMI Advisor

1. Are you satisfied with the opportunity you have to apprise the proper authority of problems or ideas for improving the demonstration? Are you satisfied with the time it takes for decisions to be made?

2. Do you feel demonstration matters are given enough attention by students and staff?

3. When there are changes in the demonstration or in your regular duties, are you given enough time to prepare for an orderly transition?

4. Are you satisfied with your participation in decisions concerning the demonstration?

5. Do you have enough time to carry out your role in the demonstration? If not, what changes in staffing or procedure would you suggest?

6. Are you satisfied with the following aspects of the demonstration facilities and operating procedures?

   - Learning center space and facilities, especially the use of the conference room tables for study, lab work and exams
   - The scheduling of study, lab work and exams, including use of materials
   - The scheduling of student interaction with the LS and ETs

(Question 6 continued)

- The procedures for keeping student and key personnel logs and entering study time into the computer

7. Are there any problems? Do you have suggestions for resolving them?

INTERVIEW QUESTIONS: Electronic Technicians

1. Are you satisfied with the opportunity you have to apprise the proper authority of problems or ideas for improving the demonstration? Are you satisfied with the time it takes for decisions to be made?

2. Do you feel demonstration matters are given enough attention by your superiors and other staff?

3. When there are changes in the demonstration or in your regular duties, are you given enough time to prepare for an orderly transition?

4. Are you satisfied with your participation in decisions concerning the demonstration?

5. Have you been satisfactorily prepared to deal with the questions raised by the students on technical matters? On administrative matters?

6. When you have to substitute for the learning supervisor, do you consider your performance of normal duties to be seriously affected. If so, what specific functions are most affected, and how? What changes would you recommend to correct the situation?

7. Do you find that maintenance work in support of the demonstration reduces your performance of regular duties? If so, what functions are affected, and how? Would you recommend changes in procedures to overcome the problem?

8. Are you satisfied with the following aspects of the demonstration facilities and operating procedures?

   - Learning center space and facilities, especially the use of the conference room tables for study, lab work and exams
   - The scheduling of study, lab work and exams, including use of materials
   - The scheduling of their interaction with the students
   - The tasks and their scheduling for ETs
   - The procedures for keeping student and key personnel logs and entering study time into the computer

9. Are there any problems? Do you have suggestions for resolving them?

INTERVIEW QUESTIONS: Students

1. Are you satisfied with the opportunity you have to apprise the proper authority of problems or ideas for improving the demonstration? Are decisions reached in a timely manner?

2. Do you feel demonstration matters are given enough attention by your superiors and other staff?

3. When there are changes in the demonstration or in your regular duties, are you given enough time to prepare for an orderly transition?

4. Do you consider your performance of normal duties to be satisfactory under the revised schedule set for the demonstration? If not, what functions are most affected, and how? What changes would you recommend to resolve the problem?

5. Are you satisfied with the following aspects of the demonstration facilities and operating procedures?

    - Learning center space and facilities, especially the use of the conference room tables for study, lab work and exams
    - The scheduling of study, lab work and exams, including use of materials
    - The scheduling of interaction with the LS and ETs
    - The tasks and their scheduling for ETs
    - The procedures for keeping student time records, logs, and entering study time into the computer

6. What other problems exist? Do you have suggestions for resolving them?

Appendix L

RECORDKEEPING AND PROGRESS REPORTING MATERIALS

This appendix contains materials related to recordkeeping and progress reporting for the CMI course. The appendix contains:

- A Laboratory and Performance Progress Sheet
- A Student Progress Sheet for LS use
- A Study/Progress Sheet for student use

Name	Rate	Carrel	Date
INDOCTRINATION TITLE	DATE	TIME	INITIAL
BEEINLES			
Service School Command			
General Military Training			
Your Rating			
Nuclear Power			

LABORATORY EXPERIMENTS must be completed successfully

PERFORMANCE TESTS are MANDATORY

LAB EXP	START STOP	WD / INT	REPEAT LAB EXP TIME	W / INT	PERF TEST	START STOP	RETAKE 1 TIME	RETAKE 2 TIME	WD / INT
3.4					**3**				
4.1									
4.3					**4**				
5.2									
5.5					**5**				
6.2									
6.3					**6**				
7.1					**7**				
9									
10.5									
11									
13					**13**				
14									

Figure L-1. Laboratory and Performance Progress Sheet

NAME ______________________ LEARNING CENTER ______________________

MATH 1	/		MOD 7-1	/	
MOD 1	/		MOD 7-2	/	
MOD 2	/		DC COMP	/	
exp 3-4	/		MOD 8	/	
PT 3	/		MATH 9	/	
MOD 3	/		exp. 9-6	/	
exp 4-1	/		MOD 9	/	
exp. 4-3	/		MATH 10	/	
PT 4	/		exp. 10	/	
MOD 4	/		MOD 10	/	
MATH 5	/		MOD 11-1	/	
exp. 5-2	/		exp. 11	/	
MOD 5-1	/		MOD 11-2	/	
exp. 5-5	/		MATH 12	/	
PT 5	/		MOD 12-1	/	
MOD 5-2	/		MOD 12-2	/	
MATH 6	/		MOD 12-3	/	
exp. 6-2	/		exp. 13	/	
exp. 6-3	/		PT 13	/	
PT 6	/		MOD 13	/	
MOD 6	/		MOD 14-1	/	
exp. 7-1	/		exp. 14	/	
PT 7	/		MOD 14-2	/	
			AC COMP	/	

Figure L-2. LS Student Progress Sheet

STUDENT STUDY/PROGRESS
SHEET

STUDY PROCEDURES

This procedure sheet is furnished for your personal use. To progress through this course in the proper sequence, you should do each of the items on this sheet in the same order in which they are listed. You may use the blank space by each item to check off the item or write in the work day when you have completed each item. If you have any questions about this procedure sheet, contact your Learning Supervisor.

- - - - - -

ITEM	WORK DAY
1. Take pre-math test.	________
2. Take math Test One (if applicable).	________
3. Study Module One, all lessons; take Mod 1 test.	________
4. Study Module Two, all lessons; take Mod 2 test.	________
5. Study Module Three, all lessons; do lab experiment 3-4.	________
6. Take Performance Test 3.	________
7. Review Module Three, all lessons; take Mod 3 test	________
8. Study Module Four, Lesson One; do lab experiment 4-1.	________

9. Study Module Four, Lessons Two and Three; do lab experiment 4-3.
10. Take Performance Test 4.
11. Review Module Four, all lessons; take Mod 4 test.
12. Take math Test Two (if applicable).
13. Study Module Five, Lessons One and Two; do lab experiment 5-2.
14. Review Module Five, Lessons One and Two; take Mod 5-1 test.
15. Study Module Five, Lessons Three thru Five; do lab experiment 5-5.
16. Take Performance Test 5.
17. Review Module Five, Lessons Three thru Five; take Mod 5-2 test.
18. Take math Test Three (if applicable).
19. Study Module Six, Lessons One and Two; do lab experiment 6-2.
20. Study Module Six, Lessons Three and Four; do lab experiment 6-3.
21. Take Performance Test 6.
22. Review Module Six, all lessons; take Mod 6 test.

23. Study Module Seven, Lesson One; do lab experiment 7-1. ________

24. Take Performance Test 7. ________

25. Review Module Seven, Lesson One; take Mod 7-1 test. ________

26. Study Module Seven, Lessons Two and Three; take Mod 7-2 test. ________

27. Review Modules One thru Seven; take the DC comprehensive examination. ________

28. Study Module Eight, all lessons; take Mod 8 test. ________

29. Take math Test Four (if applicable). ________

30. Study Module Nine, all lessons; do lab experiment 9-6. ________

31. Review Module Nine, all lessons; take Mod 9 test. ________

32. Take math Test Five (if applicable). ________

33. Study Module Ten, Lessons One thru Five; do lab experiment 10-5. ________

34. Study Module Ten, Lesson Six; review Lessons One thru Five; take Mod 10 test. ________

35. Study Module Eleven, Lessons One thru Four; do lab experiment 11. ________

36. Review Module Eleven, Lessons One thru Four; take Mod 11-1 test. ________

37. Study Module Eleven, Lessons Five thru Seven; take Mod 11-1 test. ______

38. Take math Test Six (if applicable). ______

39. Study Module Twelve, Lessons One and Two; take Mod 12-1 test. ______

40. Study Module Twelve, Lesson Three; take Mod 12-1 test. ______

41. Study Module Twelve, Lessons Four thru Six; take Mod 12-3 test. ______

42. Study Module Thirteen, all lessons; view sound slide presentation 13-4 (WV-77-E); do lab experiment 13. ______

43. Take Performance Test 13. ______

44. Review Module Thirteen, all lessons; take Mod 13 test. ______

45. Study Module Fourteen, Lessons One thru Three; take Mod 14-1 test. ______

46. Study Module Fourteen, Lessons Four and Five; do lab experiment 14. ______

47. Review Module Fourteen, Lessons Four and Five; take Mod 14-2 test. ______

48. Review Modules Eight thru Fourteen; take the AC comprehensive examination. ______

Appendix M

ANALYSIS OF COMMUNICATIONS LINE OPTIONS

1. Alternatives Considered

Three land line alternatives were considered:

- Alternative 1: A dedicated phone line leased from Pacific Telephone connecting the Stockton cluster directly with the San Diego concentrator at Building 94. This option requires the use of a 202-T modem at each end of the line. Since this line would always be available, CMI test sheets could be inserted at any time that the San Diego concentrator and Memphis CMI computer were operating. The Memphis computer operates from 0500 to 2030 CDT. The San Diego concentrator operates from 0600 PDT (0800 CDT) to 1830 PDT (2030 CDT).

- Alternative 2: A commercial dial line connecting the Stockton cluster to the MIISA San Diego concentrator when CMI messages are to be sent. This alternative requires a 202-S data set and a duplex arrangement at each end of the line.

- Alternative 3: A hybrid communications system which uses one of the two 3KHZ, 4-wire phone lines currently installed between Stockton Tech Control and NAVCOMMSTA San Diego Tech control when not required for Navy operations. These lines are available to permit Stockton to assume some of the East Pac full period termination requirements. While the past tactical usage of these lines has been low, it is anticipated that future usage will be considerably increased and hence the amount of time they would be available to the CMI demonstration is uncertain. The back-up system would be the commercial dial up system (Alternative 2). Because the dedicated and dial services require different modems, two systems are needed:

  - -- The primary system would consist of a 202-T modem connected to a phone line to be installed from the

Stockton cluster to Stockton Tech Control. From there it would be connected to one of the tactical lines to San Diego Tech Control. From here a commercial phone line would connect to the San Diego concentrator through another 202-T modem.

-- All of the equipment of Alternative 2 would still be required as a full-time backup system. Thus, the initial installation costs would be greater than Alternative 1 or 2. The only savings would be in operating costs.

In all three cases an RP6352 asynchronous line modulator is needed to connect the line to the CMI concentrator.

2. Comparison

Table M-1 shows the cost differences between the alternatives. The totals are as follows:

Alternative 1, Commercial Dedicated	$2,602
Alternative 2, Commercial Dial	$2,321 plus software modifications
Alternative 3, Navy and Dial Backup	$2,200 plus software modifications

Table M-1. Cost of Communication Line Options for Six Months

Alternative 1: Commercial Dedicated	
Component	**Cost**
Stockton:	
• 202-T dedicated line modem	$ 150 ($25/mo)
	55 (installation)
Stockton - San Diego	
• Dedicated commercial line	1,800 ($300/mo)
	200 (installation)
San Diego	
• NTC 202-T dedicated line modems	150 ($25/mo)
	55 (installation)
• Asynchronous line modulator RP6352	192 ($32/mo)
Total	$2,602
Alternative 2: Commercial Dial	
Component	**Cost**
Stockton:	
• 202-S data set, duplex arrangement	$ 270 (45/mo 202-S)
	75 (installation)
	87 ($14.50/mo duplex)
Stockton - San Diego	
• Two one-pair commercial lines	175 ($29.10/mo)
	90 (installation)
• Toll charges (est.)	1,000
San Diego:[1]	
• 202-S data set, duplex arrangement	270 ($45/mo 202-S)
	75 (installation)
	87 ($14.50/mo duplex)
• Asynchronous line modulator RP6352	192 ($32/mo)
Total	$2,321

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[1] "Extensive" software changes to the concentrator at San Diego believed to be in the order of fifteen hundred dollars would be required to accommodate a dial line.

Table M-1. (Continued)

Alternative 3: Navy Line With Dial Backup[2]	
Component	**Cost**
Stockton:	
• Connection to Tech Control	$ 400
• Backup line 202-S data set duplex arrangement	270 ($45/mo 202-S)
	75 (installation)
	87 ($14.50/mo. duplex)
• 202-T dedicated line modem	150 ($25/mo)
	55 (installation)
Stockton - San Diego	
• Navy line	0
• Two one-pair commercial lines	175 ($29.10/mo)
	90 (installation)
San Diego	
• NCS-NTC line	84 ($14/mo)
	40 (installation)
• 202-S data set, duplex arrangement for backup dial line	270 ($45/mo 202-S)
	75 (installation)
	87 ($14.50/mo duplex)
• 202-T dedicated line modem	150 ($25/mo)
• Asynchronous line modulator RP6352	192 ($32/mo each)
Total	$2,200

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[2] A portion of the dial charges shown in the commercial dial option would have to be added. Also, the same software changes to the concentrator as Alternative 1 of at least fifteen hundred dollars would be required to accommodate a dial backup.

Appendix N
SAMPLE TASKING LETTER

SPEEDLETTER

From: Chief of Naval Education and Training
To: Chief of Naval Technical Training
Commander, Naval Telecommunications Command
CO, Management Instructional Information Systems Activity

Subj: Phase III COMISAT Project Requirements; tasking of

Ref: (a) Contract No.

1. In order to meet the demonstration requirements of the COMISAT project (reference (a)), certain timely actions are required. To date, two phases have been completed. Phase I, the feasibility study, determined that distribution of CMI to ships and land bases was possible, although certain constraints were identified. Phase II developed a practical design for use within a Navy setting. Phase III involves the preparation for the demonstration. Two other phases will follow: Phase IV, the demonstration, and Phase V, the evaluation.

2. The following requested actions are required in preparation for the demonstration. Direct liaison with action and information addressees is authorized in order to determine detailed specifications.

a. CNTECHTRA

(1) Provide ten (10) complete sets of BE/E Course 69 texts, Modules 1-14, and test sheets, lab papers, Opscan administrative forms (P1, P2, P3) and terminal paper sufficient to support the experiment. To be onsite by 20 August 1977. Coordinate with the contractor.

(2) Provide two (2) complete sets of all support equipment for Course BE/E 69, Modules 1-14, to be onsite by 20 August 1977.

(3) Provide two (2) full sets of NEAT testing bounds on a no cost loan, modified with a box covering the test control knobs. Also, provide other related course/lab equipment as specified by PRC. Equipments to be onsite by 20 August 1977.

(4) Train and assign a Learning Center Supervisor. Assigned individual to be on station at NAVCOMMSTA, Stockton, California by 20 August 1977. TAD/TVL funds to be provided by CNET. IT-BE/E training should start by 18 July 1977. In order to preclude personnel or command inconveniences, more than one instructor may be used as a replacement during the duration of the demonstration.

(5) Coordinate with MIISA in identifying and monitoring files on control and study groups for collecting data on performance and attitudes. This will require a search of Course 69 records for a historic performance control group. Appropriate functional description to be provided to MIISA by 13 July 1977, by the contractor.

(6) BE/E TPC assist in identifying a group of 55 trainees to validate the attitude test at Great Lakes Training Center, and 55 trainees at Memphis. Validation to commence 18 July 1977. Validation to be completed by 12 August 1977. Specifications to be provided by the contractor.

(7) Assign a staff member to oversee the setup of the operating equipment (Training and CMI) at NAVCOMMSTA, Stockton, California. Limited short term TAD/TVL funding to be provided by CNET. Coordinate with CNET prior to commitment of funds.

b. MIISA

(1) Provide NAVCOMMSTA, Stockton, California with two (2) operative OPSCAN/Terminet clusters by 29 August 1977. Parallel acquisition paths should be concurrently pursued in order to assure selection of the earliest single delivery source. This may include modification of the existing Honeywell/OPSCAN Contract and investigation of GSA Requirements Contracts.

(2) Provide standard operative CMI telecommunication circuits and associated equipments to support the CMI equipment in Stockton. Operational cutover to coincide with OPSCAN/Terminet requirements.

(3) Request MIISA DET, San Diego, to prepare and mail in two (2) day intervals during the first month of the demonstration and weekly thereafter, student reports and other administrative support reports. Also, MIISA DET, San Diego, is to coordinate change and error resolution with the Stockton Learning Center Supervisor.

(4) Request MIISA DET, Memphis, to establish a Complex Identification Number for the Stockton trainees, estimate time to completion for a group of trainees who are representative of Stockton based on data supplied by the contractor.

(5) All technical specifications are available from the contractor. MIISA funding requirements not presently allowed for are to be provided for by CNET. Prior coordination is required before commitment of funds.

(6) Limited short term TAD/TVL funding to be provided by CNET, for MIISA DET personnel. Coordinate prior to commitment of funds.

c. COMNAVTELCOM

(1) Commence preliminary preparation leading to the receipt of detailed specifications from MIISA for a leased telecommunications line connecting the NAVCOMMSTA, Stockton learning complex with MIISA DET, San Diego. Technical data is available from the contractor. The line should be activated by 29 August 1977. All leased item funds are to be provided by CNET. Prior coordination is required before commitment of funds.

3. In order to maintain an open line of communications the following points of contact are established for coordination purposes:

CNET
CNTECHTRA
Contractor
TAEG
DARPA
MIISA DET, Memphis
MIISA DET, San Diego
COMNAVTELCOM
NAVCOMMSTA, Stockton, CA

4. Submit all costs and time charged to the project in a form suitable for analysis as specified by the contractor. The time frame for the demonstration phase of the project is from September 1977 to March 1978, allowing for setup and takedown time.

5. Detail specifications for above action items are available from the contractor. Provide telephonic verification of firm delivery dates, and completion of action items set forth to the Contracting Officer's Technical Representative (COTR). Notify the COTR in the event of delivery/completion/schedule problems.

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7. Phone discussion between B. H. Rudwick of PRC and J. Harvill, MIISA, Memphis Naval Air Station, Millington, Tennessee, June 1977.

8. Phone discussion between B. Keiser of PRC and W. Riley, Assistant National Service Manager, National Computer Systems, August 1977.

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